

Mechanick Dialling:

Or, the

New Art of Shadows:

Freed from the many

Obscurities, Superfluities and Errors

Of Former Writers upon this Subject.

The whole laid down after so plain a Method that any Person

(tho' a Stranger to the Art)

With a Pair of COMPASSES and Common RULER only,

May make a Dial upon any Plane for any Place in the WORLD,
as well as those who have attained to the greatest
Knowledge and Perfection in the Mathematicks.

Illustrated with many Copper Plates,

And

Examples of Dials for London, Exeter, Bristol, Worcester, Oxford,
Cambridge, Norwich, Lincoln, Chester, Liverpool, York, New-
castle upon Tyne, Durham, Edinburgh, Dublin, &c.

To which are added,

1. A choice Collection of *Mottos in Latin and English.*
2. A New and Correct Alphabetical Table of the most eminent
*Cities, Towns, in the whole World; shewing the Elevation of
the Pole, and the Difference of their Meridian from London.*
3. The best and most approved Methods of Painting Sun Dials.

A Work not only useful for *Artificers*, but very entertaining for *Gentlemen*,
and those *Students* at the *Universities*, that would understand *Dialling*,
without the *Trouble* of going through a Course of *Mathematics*.

By CHARLES LEADBETTER, *KL*

Teacher of the Mathematics in London.

L O N D O N:

Printed for EDWARD WICKSTEED at the Black Swan in
Newgate-Street. 1737.

✓

Mechanick Dialling:

Or the

New Art of Shadows:

Drawn from the many

Observations, Supp. Lines and Errors

Of Former Writers upon this Subject

The whole laid down with a Plainness that may be

Understood by all

With a Plan of the new and Common Rules

For making a Dial upon any Plane at any Place in the World

As also a Table of the Sun's Right Ascension and Declination

Illustrated with several Copper Plates





THE
AUTHOR
TO THE
READER.

SINCE the Business of Dialling, if Mechanically considered, is of itself a Thing so natural and easy, one would wonder, after so much learned Bustle as the Mathematicians have made about it, that they should have more perplexed and obscured than promoted the Knowledge of that useful and entertaining Art amongst the Generality of Mankind.

The different Ways, in which these Gentlemen have hitherto chose the World should see that useful Subject handled, would certainly have been right and proper, and liable to no Exception, if all Men were Mathematicians: But how few are such? And therefore their having treated of Dialling in a Geometrical Instrumental or Arithmetical Method, I am sure cannot possible be of any Use or Signification to such as know nothing at all of those Sciences or the Doctrine of the Sphere.

The Author to the Reader.

Certainly, *there are Two very different Ends of writing Books, which treat of any Art or Science; the one is to advance the Art or Science itself, and the other to instruct Learners.*

Now, with respect to the Former, the Extent and Capaciousness of the Subject is chiefly to be regarded; and nothing is to be omitted which properly falls within the Compass of the Art or Science treated of; but with respect to the Later the Capacities of the Learners are principally to be considered, and Notice is to be taken, not of whatever may be known or done by the Art or Science treated of, but only of what is most useful, and withal most easy to be known.

The most proper and rational Method, therefore, to make any one Master of any Art or Science, is to introduce it to him after the most plain familiar and natural Method, and to teach him at first only so much of the Art as is really useful in common Life, and withal most easy to be understood; and when he has gone through, and is become Master of what is most useful and easy, he will be enabled with more Ease to conquer the more difficult Parts of it, and to pursue the Study of it after a more learned Manner, if his own Inclinations or Profession shall incline him so to do.

Upon these Considerations, and with this View it was that I drew up this Treatise of Mechanick Dialling, because of all those who
have

The Author to the Reader.

have hitherto treated upon this Subject in the English Tongue for the Instruction of Learners, not one of them seems to me to have thoroughly considered, what I have now premised.

By the Method I have observed in this Treatise, the Length and Dryness of the Study of Dialling (which has discouraged many) is quite removed; and it is now rendered not only very useful, but perfectly easy and entertaining: And I think without Vanity I may venture to affirm, that by the Help of this Book only, the Learner may obtain a competent Knowledge in Dialling, in much less Time, and with much less Trouble, than he can by the Assistance of any other, or indeed all the Treatises which have yet appeared in English upon this Subject: where he will either find the easy and useful, and the difficult and useless Elements of this Art promiscuously and injudiciously exhibited and taught together; or else the Subject treated of after such a manner as can never be comprehended by any one that does not understand some of the abstrusest Branches of the Mathematicks. But*

It is high Time that I should now proceed to give the Reader the Particulars of what he may expect to meet with in the following Treatise.

* Such as Geometry, Astronomy, &c.

The Author to the Reader.

In the first Place, he is made Master of those few Geometrical Problems, which may be of Service to him in Mechanick Dialling.

Secondly, I have taught him not only the Use of the Quadrant and Trigon, but also how to make those universal Instruments, which for their Simplicity, and the great Use they are of in Dialling are never enough to be valued. I have likewise taught him not only the Use of, but also how to make Dialling Scales, and this is not to be met with in any other Treatise extant upon this Subject.

Thirdly, I have given him such plain and ample Directions, that it will be impossible for him to miscarry in making of a Dial for any Place in the World, whether the Dial be Equinoctial, Horizontal, Erect, Declining Reclining or Inclining.

Fourthly, To these I have added plain and easy Directions for making of Reflective, Refractive and Globe Dials.

I have likewise taught the Reader how to make a Cross Dial, and in this, on account of its Novelty, I have been very full and particular, not only in shewing him after what manner it must be made, but in having the several necessary Views or Positions of it engraved in Copper. I was tempted to be thus particular, by reason I never yet saw or heard there was any other Dial of that Sort in England, besides that which I have mentioned in this Treatise.

Fifthly, *I have furnished the Reader with the following very useful and accurate Tables.*

1. *A Table of the Sun's Declination exactly calculated for the Year 1738, which (for the Use of Dialling) will serve for this Age without any sensible Error.*

2. *An exact Table of the Equation of Time for the Regulating of Clocks and Watches by a Sun Dial.*

3. *A Table for the Converting of Hours and Minutes of Time into Degrees and Minutes of the Equinoctial, and e contra.*

4. *A Table for Drawing the Hour Lines upon all Horizontal, &c. Dials from the Equinoctial to the Poles.*

5. *A Table of the Three Requisites in Dialling, shewing the Substyle's Distance from the 12 a Clock Hour Line; the Style's Height, and the Inclination of Meridians answering to the several Degrees of the Declination of your Plane.*

6. *A Table shewing the Sun's Altitude for every Hour and Quarter of the Day, at his Entrance into the 12 Signs of the Zodiack.*

Sixthly, *I have given a plain and familiar Description of the Sphere, for the Sake of such as are inclined to have a true Notion of such Circles in the Heavens, as are frequently mentioned in this and other Books of Dialling.*

Seventhly, *In Chap. XXIII is a Collection of Mottos for Dials in Latin and English,*

suitable to almost all Places where Dials may be fixed.

Eightly, And that nothing might be wanting to render this Work compleat, I have added a new and correct Alphabetical Table of the most eminent Cities, Towns, &c. in the whole World, shewing at each Place the Elevation of the Pole, and Difference of their Meridian from London, and this Table may be depended upon to be the best that is extant, because I have spared neither Time nor Pains to correct as many as I could from celestial Observations.

Ninthly, In Chap. XXVI I have been very full and particular concerning the manner of making and painting of Dial Planes, and also concerning the preparing the different Colours and Oyls proper for that Purpose; and in this I hope to merit the Approbation of those who live in the Country, and cannot upon all Occasions have the Assistance of a professed Painter.

And I have also added Chap. XXVII concerning Painting Houses, &c. being thoroughly convinced that all those Country Gentlemen, and others, who are inclined to be good Husbands, will think it very well worth their Perusal.

Lastly, Though it may appear a little foreign to my present Purpose, yet for the Entertainment of the curious, I have shewn (in Chap. XXV.) how naturally the Two
Hands

The Author to the Reader.

Hands of a Watch or Clock represent the Motions of the Sun and Moon.

At the Request of my ingenious Friend Mr Edward Hauxley, I have added his curious Question in Dialling, with his general Solution, it being till now never answered by any one, and I am perswaded it will be acceptable to the curious Reader.

And now wishing my Reader as much Benefit from the perusal of this Treatise, as I have had Pleasure in composing of it, I remain his faithful Friend whilst

London, May

16. 1737.

CHARLES LEADBETTER.

☞ N. B. In CHAP. XIX where I treat of a *Window Dial*, I have advised you *first* to make a Draught of your Dial upon *Paper*; which I take this Opportunity to recommend, as a very good and practical Method; especially if your Dial be for an *Erect Direct*, or *Erect Decliner*, or *Reclining Inclining Plane*: Then, I say, (after you have found the *Declination of the Plane*, as taught in *Chap. X.*) procure a large Sheet of thick writing Paper, and thereon make the Draught of your Dial (according to the respective Directions for making those Dials) which done, either with *Wax* or a few small *Nails*, fasten your *Paper Draught* to the Plane (which I suppose to be made ready for that Purpose) upon which you design to draw the Dial. Having placed the *Center* of your *Paper Dial* in the *very Place* where you design to fix the *Style* in the Plane, there fasten a String, and with this String transfer the *Hours* and *Quarters* from your *Paper Draught* to the *Plane*. And this you will find to be a very easy, expeditious, and exact Way of drawing the *Hour Lines* and *Quarters* upon any Plane whatsoever.

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Heads, with great Variety of **CASES** extracted from the
Reports. Together with all the Rules of the said Courts
brought down to the Year 1719. Collected by the Author,
JOHN LILLY, Gent. The Second Edition. In which
are comprized the Rules of the respective Courts, brought
down to this present Year, and likewise (under their several
Heads) all the Cases reported since the Publication of the
former Edition. To which are added, Two **TABLES** :
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plained throughout this whole Work; the Other, of the
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fection, and at the lowest Prices, and sold by John Fowler
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Cronton	— 38	Port Royal	—	117
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Edinburgh	— 61	St Thomas Island	—	34
Exeter	— — 33	Worcester	—	57
Liverpool	— — 38	Warrington	—	38
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Norwich	— — 50			

Mechanick

(I)

OF
Mechanick Dialling.

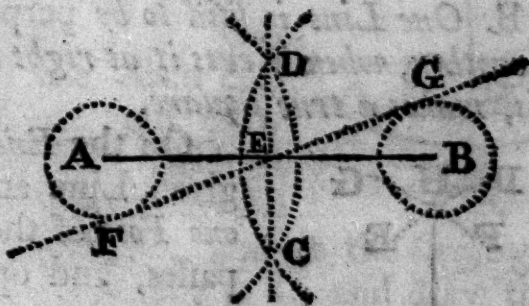
CHAP. I

CHAP.
I.

*Treats of things necessary to be known
by the Mechanick Dial-maker.*

PROB. I.

TO divide a right Line given (as A B)
into two equal Parts.



Open your Compasses to any extent *more*
than *half* the *Length* of the Line A B;
set one Foot in A, and describe the *Arch*
B D C,

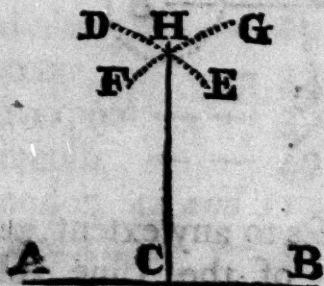
CHAP. D C, then with the *same Extent* of the

I. Compasses, set one foot at B, and describe the *Arch* D C on the other Side: where these two Arches *cross* each other, lay a Ruler, and draw the *right Line* D C, and it will divide the right Line *given* in E, the *middle* thereof: *or* the same given right Line may be divided into *two equal Parts*, by setting one Foot of the Compasses on the *end* of the Line at A, and there describe the dotted Circle, and then with the *same Extent* of the Compasses, draw the *other* dotted Circle at B; lastly, draw the right Line F G, and it will divide the given right Line A B in E, as before.

PROB. II.

To erect or raise a Perpendicular, on the middle of a given right Line.

N.B. One Line is said to be perpendicular to another, when it cuts it at right Angles, that is, makes a true Square.



On the *End* of the given Line at A, set one Foot of the Compasses, and open the other to any Extent, more than *half* the Length of the Line, and describe the Arch D E; with the *same Extent* set one Foot of the

Mechanick Dialling.

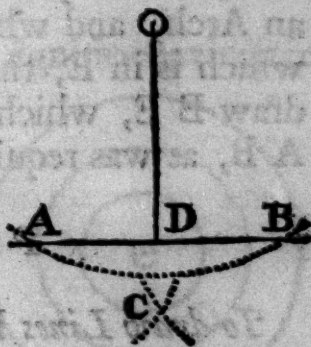
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the Compasses at B, and draw the Arch **CHAP.**
F G; lay a Ruler to C, *the Middle* of the **I.**
 given Line, and to the *Crossing* of the 
two Arches, and draw **CH**, which will be
perpendicular to **AB**, as was required.

PROB. III.

*To let fall a Perpendicular as $\odot D$ upon
 a right Line, from a given Point above.*

Let *the Point above* be $\odot$, and the given
 right Line **AB**; set one Foot of your Com-
 passes in $\odot$, and extend the other Foot to
A, and describe the Arch **AB**; set one
 Foot of the Compasses in **A**, where the
 Arch cuts the given
 Line, and draw an
 Arch at **C**, with the
same Extent; then set
 one Foot in **B**, *viz.*
 where the Arch cuts
 the Line, and draw
 another little Arch at
C; lay a Ruler to the
 given Point $\odot$, and to the *Crossing* of the
 two little Arches at **C**, and draw the Line,
 $\odot D$, so it will be at right Angles to **AB**,
 as was required.



B 2

PROB.

To erect a Perpendicular at the End of a given Line.

Let the given right Line be A B, and from the End B, let it be required how to *erect a Perpendicular*, as B E; open your Com-



passes to any convenient Distance as B C and draw the Arch C D; lay a Ruler to C and D, and draw the dotted Line C D E as long as you please, take the Distance C D in your Compasses, and set from D

to E, where you may if you please strike an Arch, and where it cuts the Line C E which is in E, there lay a Ruler to B, and draw B E, which shall be *perpendicular* to A B, as was required.

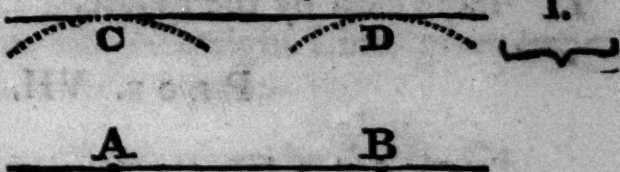
PROB. V.

To draw Lines Parallel to each other.

Parallel Lines are those that being continued ever so far will never meet.

Let the Line given be A B, unto which I would draw a parallel Line: open your Compasses to any *convenient* Distance, and set one Foot in A, draw an Arch at C, [and carry

carry *this* Extent to B: then draw the Arch CHAP.
at D, lay a Ruler to touch the Arch C and D, and draw the right Line C D, which is parallel to A B, as was required.

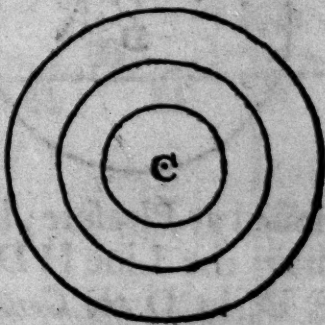


N. B. There is a Ruler sold at the Mathematical Instrument-makers, which greatly supplies the use of this Problem, known by the Name of the *Parallel Ruler*, which I recommend to all my Readers as very useful.

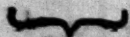
PROB. VI.

To draw Parallel, or Concentric Circles.

The Word *Concentric*, signifies having the same Center, and several Circles drawn from the same Center, are said to be *concentric*: therefore set one Foot of your Compasses in C, the Center, and open the other Foot to the Distance of your Circle intended, and draw a Circle; keep the Foot of your Compass in the same Center, and open the other to the Distance of another Circle; which draw,



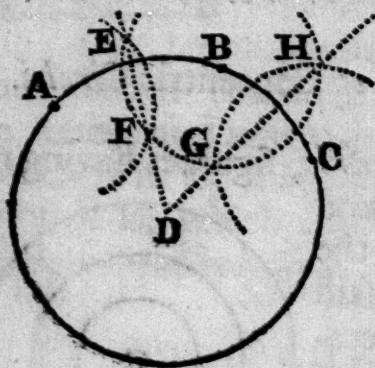
CHAP. and do so by as many as you intend, as is
I. more clear by the Figure.



PROB. VII.

To find a lost Center, which is the same as to find a Center that will pass through any three Points not in a right Line.

Let the three Points given be A B and C, through which I would draw a Circle. Set one Foot of the Compasses at A, and open them to any Extent *more than half* the Distance A B, and draw the Arch E F; carry the same Extent of the Compasses,



and set one Foot in B; draw the Arch E G H, with the same Extent; set one Foot in C, and draw the Arch H G; lay a Ruler to E F, and draw the Line E D con-

tinued at Pleasure; lay a Ruler to H G, and draw the Line H D, and it will meet with E D, in D the Center of the Circle, from which Center draw a Circle with the Distance D A, and it will pass thro' the three given Points A B C, as was required.

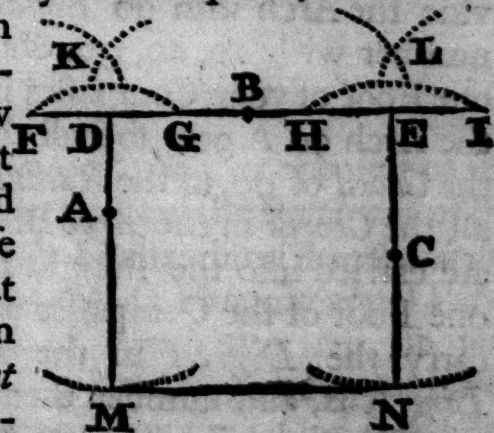
PROB.

PROB. VIII.

Three Points *not in a right Line*, given 
to make a Geometric Square.

Let the *three Points* given be A, B, C; thro' the Point B draw, the Line F I, set one Foot of the Compasses in the Point A, and draw the Arch F G; set one Foot of the Compasses in the Point C, and draw the Arch H I; set one Foot of the Compasses in H and I *severally*, and draw the the two Arches at L; set one Foot in F and G *severally*, and draw the two Arches at K; lay a Ruler to L and C, and draw a Line *with the point of your Compasses*; lay a Ruler to K and A, and draw another Line *with the point of your Compasses*; then take D E in your Compasses, and set one

Foot thereof in D and E *severally*, and draw the Arches at M and N, and where those Arches *cut* that Line drawn with the *point* of your Compasses, *that* determines the length of the Lines D M, and E N, which draw *with Ink* and 'tis done.





PROB. IX.

To make a Line of Chords to any assigned Radius or Length.

Plate 2. Fig. 1.

Radius in Geometry signifies *half* the *Diameter* of any Circle *Equal* to *C B*; and the *Chord* of an *Arch*, is like the string of a Bow: *i. e.* it is a Line drawn from any *Point* in the Circumference of a Circle, to any other *Point* in the same Circle, as the Lines *B 10*, *B 20*, *B 30*, *B 40*, *B 50*, *B 60*, *B 70*, *B 80*, *B 90*, are the *Chords* of their respective *Arches*.

First, draw the *Quadrant B C 90*, and divide the *Arch* into 90 *Equal* Parts, which number with 10, 20, 30, &c. to 90 *Deg.* set one Foot of your *Compasses* in *B*, and draw the *Arch 90 A 90*; so shall the Line *A B* be the *Chord* of 90, to the *Radius C B*; (because all the *Chords* in the *Arch B. 10*, 20 and 90. are carried into the streight Line *A. B.*) set one Foot of the *Compasses* again in *B*, and carry the *Degrees* in the *Arch* into the Line *A B*, and number them with 10, 20, 30, &c. from *B* to 90 at *A*, so shall you have a *Line of Chords*, and thus may you make one of what Length you please.

PROB.

Mechanick Dialling.

9

CHAP.

I.

PROB. X.

To draw a Line, or Scale of six Hours.

Plate 2. Fig. 2

With any convenient opening of the Compasses draw the *Quadrant* A B C, divide the *Arch* into *six* equal Parts, and draw the *Chord* A C; lay a Ruler to the Center B, and to every Division in the Arch, and it will divide the *Chord* A C into a Scale of Six Hours, see the Figure.

PROB. XI.

To make a Scale of Inclination of Meridians.

Plate 2. Fig. 3.

With the same *Radius*, or opening of the Compasses that you drew the *Quadrant* of the Scale of the Six Hours, draw the *Quadrant* A B C, divide the Arch into *nine* equal Parts, and every one of them into *ten*, so will the *Quadrant* be divided in 90 equal Parts, or Degrees; then draw the *Chord* A C; lay a Ruler to the Center B, and to every Division in the Arch, and it will divide the *Chord* A C into a Scale of Inclination of Meridians,

CHAP. *Meridians, equal to that of the Scale of six*
 I. *Hours.*

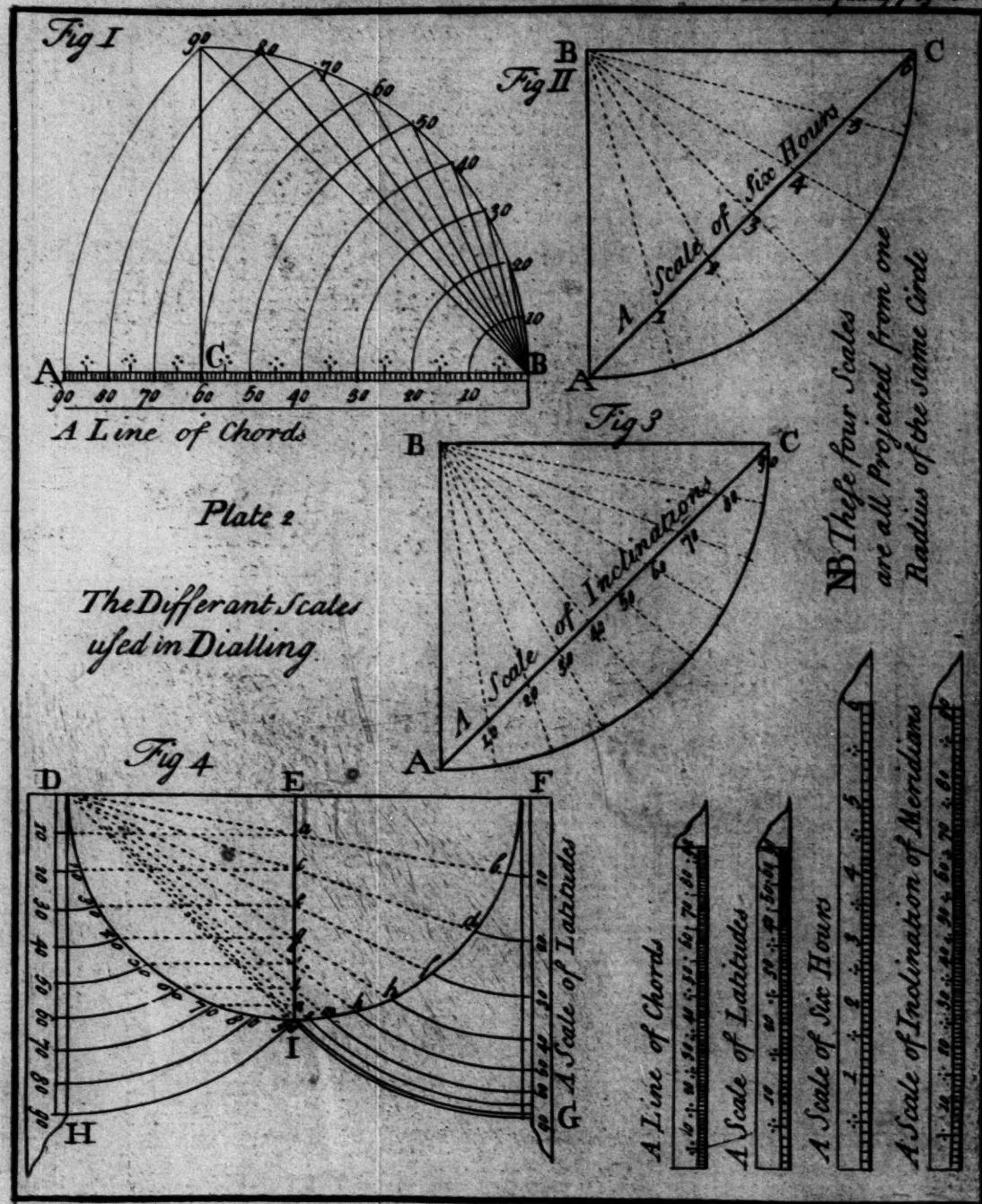
PROB. XII.

To make a Line, or Scale of Latitudes.

Plate 2. Fig. 4.

To proportion this Scale to the *other two* last mentioned, *the Scale of Latitudes* must be the *Chord* of 60 Deg. to the *same Circle* in which the *Scale of six Hours* is the *Chord* of 90 Deg.

In either of the Problems X or XI, set one Foot of the Compasses in B, and take the *nearest* Distance to the *Chord* A C, with *that* Extent draw the *Semicircle* D I F, and divide the *Quadrant* D I into 90 *equal Parts* or *Degrees*, and number them with 10, 20, 30, &c. to 90, then by *Prob. V.* or rather with your *Parallel Ruler*, draw the Lines 10 *a*, 20 *c*, 30 *e*, &c. *parallel* to D E; lay a Ruler to D, and to *a*, *c*, *e*, *g*, *i*, *l*, *p*, and I *severally*, and draw D *a b*, D *c d*, D *e f*, D *g h*, D *i k*, D *l m*, D *n o*, D *p q*, and D I, and setting one Foot of the Compasses in F, *carry* the Points *b*, *d*, *f*, *h*, *k*, *m*, *o*, *q*, and I, into the Line F G, and number it with 10, 20, 30, 40, 50, 60, 70, 80, 90, which shall be a *Line of Latitudes* to the given *Radius*. Lastly, *carry*



Mechanick Dialling.

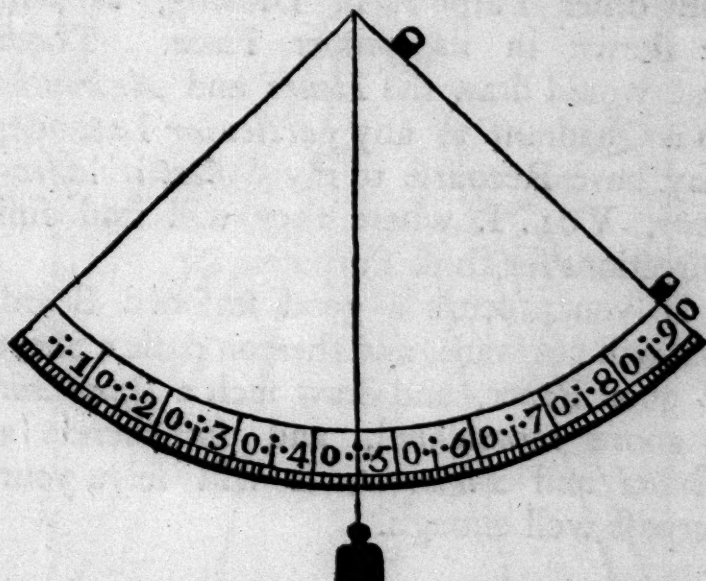
II

carry the Points 10, 20, 30, 40, 50, 60, CHAP.
70, 80, 90, in the Arch DI, into the Line I.
DH, and that shall be a *Line of Chords*,
answering the *Line of Latitudes*, *Inclina-*
tion of Meridian and *Hours*.

PROB. XIII.

To make a Quadrant.

A QUADRANT, is a very useful Instrument in Dialling, and is the *fourth Part* of a Circle, of any opening of your Com-



passes, whatever you please: The *Limb*, or *Arch* thereof, is divided into 90 *equal Parts*, called *Degrees*, and numbred with 10, 20, 30, &c. to 90. It has on one *Edge* two *Sights*, as the annexed Figure. There are
two

CHAP. two Sorts commonly sold in *London*, known

I. by the Names of *Gunter's* and *Collins's* Quadrants, which have Lines of *Hours* and *Azimuth*, drawn on the *Face*, to shew the *Hour* of the Day or Night, and the *Azimuth*, of the Sun, at any time, for the Latitude of *London* only.

N. B. If you buy either of these Quadrants, and take them far *North* or *South* from *London*, they will there be of no Service to you in finding the *Hour* and *Azimuth*, but only in taking an *Altitude*, and other Purposes in Dialling, as will be shewn in its proper Place. Those that would draw the *Hours* and *Azimuths* on a Quadrant to any particular Latitude, may have Recourse to my *System of Astronomy*, VOL. I. where they will find full Directions for those Purposes.

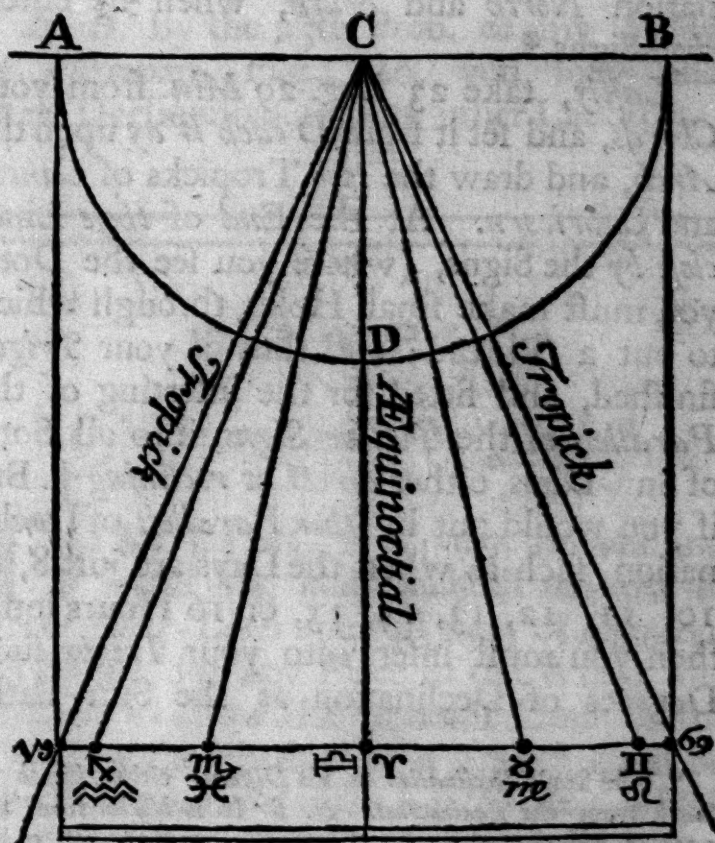
If you procure a good seasoned Board that will not warp, and thereon paste a Sheet of good Paper, and draw such a Quadrant as above represented, and fix thereto a Thread and Plummet, it will serve your purpose well enough.

PROB. XIV.

To make a Trigon.

The TRIGON is likewise a very useful Instrument in Dialling, and may be made upon a thin Board, or Sheet of good Paste-Board,

Board, as is the Figure A B ∞ v, of any CHAP. I.
 convenient Size you please. At right Angles
 to A B, draw C D v, which shall represent
 the *Equinoctial*: with the *Chord* of 60 De-
 grees, draw the *Semicircle* A D B; Take in
 your Compasses from the Line of Chords (Plate
 2. Fig. 1.) 11 Deg. 30 Min. (for such is the
 Sun's Declination when he enters γ π North,
 and m $\times$ South,) and set one Foot in the



Point D, that is where the *Equinoctial* C D v,
 cuts the *Semicircle*, and turn the other Point
 each

CHAP. *each way* upon the Arch, there make Marks,

I. and draw C $\propto$ m, and C m $\times$: These two

Lines shall represent the *Sun's Declination* in the *Trigon*, when he enters *those Signs*. Take 20 Deg. 11 Min. from your *line of Chords*, (Plate 2. Fig. 1.) and set it from D, *each Way* upon the *Arch*, and thro' *those Points* draw C π Ω , and C $\dagger$ ∞ , these two Lines in the *Trigon* shall represent the *Sun's Declination North and South*, when he enters *those Signs* *.

Lastly, take 23 Deg. 29 Min. from your *Chords*, and set it from D *each Way* upon the *Arch*, and draw the two Tropicks of *Cancer* and *Capricorn*. At the *End* of *those Lines* close by the *Signs*, (where you see the *Dots*) you must make small Holes, through which to put a Thread; and thus is your *Trigon* finished, and fitted for the inserting of the *Parallels* of the *Twelve Signs*, into all Sorts of *Sun-Dials*, either *direct* or *reclining* †. But if you would put in *other Parallels* of *Declination*, such as when the *Days* are just 8, 9, 10, 11, 12, 13, 14, 15, or 16 Hours long, then you must insert into your *Trigon* such *Degrees of Declination* as the *Sun* hath,

* The *Sun's Declination* is his *Distance* either *North* or *South* from the *Equinoctial*. N. B. It is *North* from the 10th of *March* to the 12th of *September*, and the rest of the Year it is *South*. See Table I.

† The *Parallels* of the 12 *Signs* are the *Sun's Declination* that Day that he enters any *Sign*; as for Example *Taurus* 11 Deg. 30 Min. as you find it in Table I.

when

when the Days are so many Hours long,
as you would describe upon your Dial: and
so in the Latitude of *London*, CHAP.
II.

				Deg.	Min.	
when	8		16	Hours	21	40
the	9	or	15	long	16	55
day is	10		14	the sun	11	37
either	11		13	hath	5	55
						Of Declination.

N. B. By the 25th Prob. of my *System of Astronomy*, Pag. 146, you may find these Declinations for any other Latitude.

CHAP. II.

Of DIALLING in general.

DIALLING is a very curious and *Dialling*
useful Art, and teacheth us how to *what.*
draw *Hour-Lines* upon all sorts of *Surfaces*,
or *Planes*, for any Place in the World, and
thereby to know the apparent Hour of the
Day, by the Shadow of a *Style* * fixed on
the Plane *parallel to the Earth's Axis*, which
Style can have no more than *three* Positions,
viz.

* The *Style* in Dialling, signifies the Pin or Cock of a
Dial, the Shadow of which points out the Hour.

CHAP. viz. *Perpendicular, Oblique and Parallel,*
 II. which shall be shewn in their proper Places †.

The various Position of the Style or Gnomon of a Dial. The *Dial-Planes*, on which Hour-Lines are drawn, are these following.

The Horizontal	} Dial-Plane.
The North and South erect direct	
The erect Decliner	
The Reclining Inclining	
The Reclining Declining	
The Convex	
The Concave	

Of the *Equinoctial* Dial, and why first treated of.

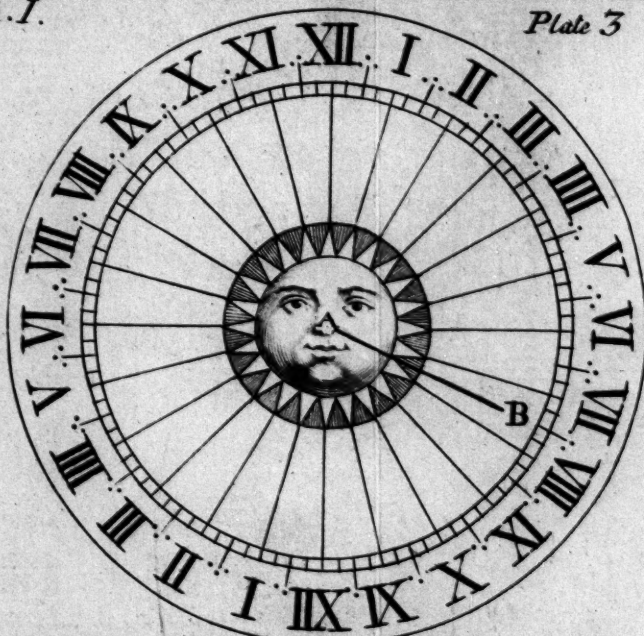
The *Equinoctial* Dial-Plane, is that which is *parallel* to the Plane of the *Earth's Equator*, and is *universal*, for Hour Lines drawn thereon, will shew the apparent Time of the Day in any Place of the World; and because this is the *Ground and Foundation* of all other Dials, therefore I shall begin *first* with it, and in the Course of this Work shall shew how naturally the *Hour-Lines* upon all Sorts of Dial-Planes, are deduced from the *Equinoctial* Dial.

† The whole Business of Dialling may be reduced to *three* general Heads; the *first* consists in finding the Place of the *Substyle*, or where the *Style* is to be placed; The *second* in drawing the *Hour-Lines*: and the *third* and last, if the Dial-Plane be *moveable*, in duly placing and fixing the same, after that the Dial is drawn thereon; or else, if the Plane whereon the Dial is to be drawn, be *unmoveable* and already fixt, in finding the *Position* or Situation of the said Plane, viz. whether it be a *Direct* or *Declining* Plane; and if the *latter*, how far it *declines*.

C H A P.

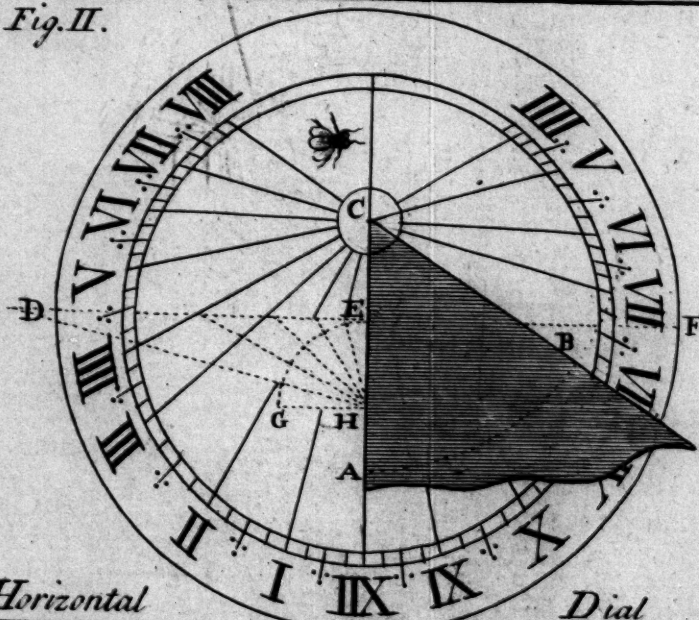
Fig. I.

Plate 3



An Equinoctial Universal Dial

Fig. II.



Horizontal

Dial

*A new correct alphabetical Table of the principal CITIES and TOWNS in England, Scotland, Ireland, and Wales *, shewing at each Place the Elevation of the Pole, and Difference of their Meridians from London.*

✂ The *Elevation of the Pole* signifies the same as the *Latitude of the Place*, and the *Difference of Meridians* the same as the *Longitude of the Place*.

Note,

D } signifies { Degrees
H } { Hours
M } { Minutes

E } signifies { East
W } { West
N } { North
S } { South

Longit.
Latit.

England.		Latitude.		Diff. Merid.	
		D.	M.	H.	M.
B Edford		52	8	0	2
Berwick		55	47	0	6
Bristol		51	30	0	11
Buckingham		51	56	0	4
Bath		51	21	0	10

* There is a Table of the most eminent *Cities and Towns* in the *WORLD* at Page 136.

(*B)

Cambridge

(18) *A new Table of the Elevat. of the Pole, and*

CHAP.

2.

	Latit.		Dif. Mer.	
	D.	M	H.	M
Cambridge	52	17 N	0	0
Canterbury	51	18 N	0	5 E
Carlile	54	56 N	0	11 W
Chichester	50	56 N	0	2 W
Chester	53	12 N	0	12 W
Colchester	51	55 N	0	4 E
Coventry	52	26 N	0	6 W
Cronton in Lancashire	53	22 N	0	12 W
Derby	52	55 N	0	6 W
Dorchester	50	46 N	0	10 W
Durham	54	48 N	0	6 W
Dover	51	10 N	0	6 E
Exeter	50	44 N	0	14 W
Falmouth in Cornwall	50	9 N	0	22 W
Flamborough	54	7 N	0	1 E
Gloucester	51	53 N	0	9 W
Guilford	51	14 N	0	3 W
Hull	53	46 N	0	1 W
Hertford	51	48 N	0	0 W
Hereford	52	4 N	0	11 W
Huntington	52	19 N	0	1 W
Harborough, Leicester-				
shire	52	30 N	0	5 W
Ipswich	52	10 N	0	5 E
Kendal	54	14 N	0	11 W
Lancaster	54	5 N	0	11 W
Leicester	52	37 N	0	5 W
Lincoln	53	12 N	0	2 W
London	51	32 N	0	0
Liverpool	53	22 N	0	12 W
				Litchfield

Difference of Merid. for G. Britain, Ireland, &c. (19)

	Latit.		Dif. Mer.		CHAP.
	D.	M	H. M		2.
Litchfield	52	43 N	0 8	W	}
Manchester	53	32 N	0 9	W	
Northampton	52	50 N	0 6	W	
Norwich	52	43 N	0 6	E	
Nottingham	52	58 N	0 4	W	
Newcastle upon Tyne	54	57 N	0 6	W	
Oxford	51	45 N	0 5	W	
Orfordness	52	12 N	0 6	E	
Ormskirk	53	30 N	0 12	W	
Peterborough	52	33 N	0 2	W	
Penzance, Cornwall	50	8 N	0 24	W	
Portsmouth	50	45 N	0 5	W	
Preston, Lancashire	53	42 N	0 11	W	
Richmond, Yorkshire	54	25 N	0 6	W	
Rochester, Kent	51	25 N	0 3	E	
Salisbury	51	4 N	0 8	W	
Shrewsbury	52	44 N	0 11	W	
Stafford	52	50 N	0 9	W	
Stamford Line	52	37 N	0 2	W	
Southampton	50	55 N	0 6	W	
Truro	50	19 N	0 22	W	
Wigan	53	34 N	0 11	W	
Weymouth	50	36 N	0 11	W	
Warwick	52	18 N	0 6	W	
Winchelsea	50	54 N	0 3	E	
Winchester, Hants	51	3 N	0 5	W	
Wolverhampton	52	38 N	0 9	W	
Worcester	52	14 N	0 9	W	
Woodstock	51	53 N	0 6	W	
Warrington	53	22 N	0 10	W	
	(*B 2)		Wells,		

(20) *A new Table of the Elevat. of the Pole, and*

CHAP.

2.

Wells, Somerset
York
Yarmouth, Norfolk

Latit. Dif. Mer.
D. M H.M

51 11 N 0 11 W
53 55 N 0 4 W
52 46 N 0 7 E

Wales.

Beaumaris
Brecknock
Bangor, Bishop's See
Cardigan
Carmarthen
Carnarvan
Cardiff
Denbigh
Harlech in Merioneth-
shire
Flint
Landaff
Monmouth
Montgomery
Milford
Pembroke
Radnor
St Davids
St Asaph
Wrexham
Welshpool

53 18 N 0 17 W
52 0 N 0 13 W
53 21 N 0 17 W
52 10 N 0 19 W
51 52 N 0 18 W
53 10 N 0 18 W
51 32 N 0 13 W
53 11 N 0 14 W
52 55 N 0 17 W
53 14 N 0 13 W
51 33 N 0 13 W
51 50 N 0 11 W
52 34 N 0 13 W
51 43 N 0 20 W
51 45 N 0 20 W
52 21 N 0 12 W
52 1 N 0 22 W
53 18 N 0 14 W
53 6 N 0 13 W
52 40 N 0 12 W

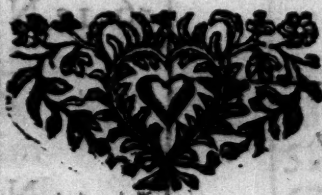
British

Difference of Merid. for G. Britain, Ireland, &c. (21)

	Latit.	Dif. Mer.	CHAP.
	D. M	H. M	2.
<i>British Islands.</i>			
A nglesey Middle	53 20 N	0 18 W	
Guernsey	49 36 N	0 11 W	
Jersey	49 28 N	0 14 W	
Lundy	51 20 N	0 15 W	
Man	54 25 N	0 18 W	
Portland	50 30 N	0 11 W	
Wight	50 37 N	0 6 W	
Yarmouth in Ditto	50 41 N	0 7 W	
<i>Scotland.</i>			
A berdeen	57 6 N	0 6 W	
Dunbar	56 7 N	0 9 W	
Dundee	56 30 N	0 10 W	
Dunblain	56 18 N	0 16 W	
Dunkel	56 39 N	0 13 W	
Edinburgh	56 7 N	0 12 W	
Glasgow	55 50 N	0 17 W	
Leith	55 58 N	0 12 W	
Orkney	60 6 N	0 14 W	
St Andrews	56 23 N	0 10 W	
Stirling	56 12 N	0 15 W	
<i>Ireland.</i>			
A Ntrim	54 44 N	0 27 W	
Arglas	54 19 N	0 24 W	
Ardmagh	54 20 N	0 28 W	
Belfast	54 36 N	0 27 W	
		Caterlagh	

(22) *A new Table of the Elevat. of the Pole, &c.*

CHAP.	Latit.	Dif. Mer.
2.	D. M	H. M
 Caterlagh	52 48 N	0 29 W
Clare	52 41 N	0 37 W
Cork	51 45 N	0 38 W
Colerain	55 8 N	0 29 W
Drogheda	53 49 N	0 27 W
Dublin	53 20 N	0 28 W
Dundalk	54 4 N	0 28 W
Galloway	53 10 N	0 40 W
Kenny	52 39 N	0 30 W
Kildare	53 11 N	0 29 W
Kingfale	51 31 N	0 38 W
Londonderry	54 55 N	0 32 W
Lymerrick	52 22 N	0 39 W
Mariborrow	53 0 N	0 31 W
Philipston	53 15 N	0 31 W
Tuam	53 26 N	0 37 W
Waterford	52 12 N	0 30 W
Wexford	52 20 N	0 27 W
Youghall	51 51 N	0 33 W

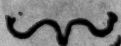


CHAP.

Of the Equinoctial Dial.

17

CHAP.
III.



CH A P. III.

*To make an EQUINOCTIAL * Dial.*

Plate 3. Fig. 1.

THIS Dial of all others, is the most simple and easy to be drawn, and is thus made.

The Equinoctial Dial the most easy and useful.

Take a *flat* Plate of Brass, about a Foot square; or if you cannot easily procure Brass, get a piece of good dried Oak well planed on both sides.

For the Hour Lines.

Draw with your Compasses *three* † *Concentrick Circles* thereon, to contain the Figures, which divide into 24 *equal Parts*; then lay a Ruler to the *Center*, and draw Lines to those *equal Divisions* in the *Circle*, and they shall be the true *Hour Lines* sought.

For the Style.

Erect in the *Center* of the Plate a Pin or Wire *perpendicular* to the Plane, as A B,

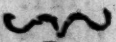
* *Equinoctial Dials* are those whose *Plane* or *Face* lieth parallel to the Equinoctial.

† See Problem 6. Page 5.

C

and

CHAP. and that shall be the *Style* truly fitted to the
III. Dial.

 You must observe that 15 Deg. || in the
15 Deg. *Equinoctial* is one Hour in Time, as you may
in the see more at large by Table III; and there-
Equinocti- fore if you take 15 Deg. from your *Line*
al equal to of *Chords*, and set it off from the 12 a-clock
one Hour in Time. *Line each way*, that will give you the
Hours of 11 and 1, and 30 Deg. will give
you the Hours of 10 and 2, &c. and thus
the whole *Equinoctial Circle* will be divided
into 24 equal Parts or Hours, as above.

How to
make this
Dial serve
for the
whole
Year.

Of the
Style.

But because this Dial when thus drawn
on one surface or side of the Plane, will
serve only for one half of the Year, viz.
while the Sun is on one side of the *Equinoctial*,
to wit, from the 10th of *March* to the 12th
of *September*; and therefore to make it
serve for the whole Year, it must be doubly
drawn, i. e. on the lower, as well as on
the upper side or surface of the Plane, and
then the Wire which serves for the *Style*
must go through the Center, and must ex-
tend itself 6 or 8 Inches more or less beyond
the surface of the Plane, and stand at right
Angles therewith; and then is that Dial

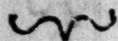
|| Throughout this Book you will find continual mention
made of *Degrees* and *Minutes*, therefore you are to remember
that a *Degree* is the 360th part of any Circle; each of which
Degrees is supposed to be divided into 60 *Minutes*; so that
45 *Minutes* is three *Quarters* of a *Degree*, 30 *Minutes* half
a *Degree*, and 15 *Minutes* a *Quarter* of a *Degree*, &c. See
Table III.

finished.

finished. How naturally the *Hour Lines* of CHAP.
all Dials are drawn from the *Equinoctial* III.
Dial is shewn in Chapter XXI. ~

To set this Dial truly.

You must raise the Wire which represents the *Style* to the *Latitude* of your Place, by applying that edge of your *Quadrant* in which the Sights are fixed to the *Style*, and when the *Thread* cuts the *Limb* in the *Degrees* of the *Latitude* of your Place, then doth the *Style* point to the *Poles of the World*, and the Dial itself lieth parallel to the *Equinoctial Circle* in the Heavens: But still here wants a true 12 a-clock Hour Line, which must be found as I shall shew in the next Chapter, and then placing the Dial, so that at 12 a-clock the *Shadow* of the *Style* may fall in the 12 a-clock Hour Line, that you find by the Directions following; and thus will your Dial be truly placed, which you may fasten by fixing two Pieces of Iron at each end of your 12 a-clock Hour Line upon your *Dial Post*, and in those put the *Style* of the Dial to the height, which was found before by the help of your *Quadrant*.



To make an HORIZONTAL * Dial.

Plate 3. Fig. 2.

The Horizontal
Dial the
most useful
of all Dials.

THIS is the most *useful* Dial of all others, because the Sun stayeth upon it from his *Rising* to his *Setting* in all Places of the World, wheresoever you be.

Not material what
Form the
Plane is of,

It matters not what Form the Plane on which you would draw an *Horizontal Dial* is, whether it be *Round*, *Square*, or *Triangular*, but they are generally drawn round as on Plate 3. Figure 2. in which when you have drawn *three Concentric Circles*, as a margin to contain the Figures; draw the Line *C A* which shall represent the *12 a-clock Line*, and also the *Substyler Line*, in which make choice of a Point, as at *C* a little above the *Center*, (for by that means you will enlarge the distances of the *Hour Lines*) and through it draw the Line *VI. C. VI.* for the *6 a-clock Hour Line*. In the *substyler Line* † as at *E*, make choice of another Point, and through that at right Angles

which is
the Center
of an Horizontal
Dial.

* *Horizontal Dials* are those whose *Plane* or *Face* lies parallel to the *Horizon* of the Place.

† The *Substyler Line* in Dialling is that Line drawn upon the *Plane* or *Face* of the Dial, over which the *Style* stands perpendicular

Of the Horizontal Dial.

21

gles to the 12 a-clock Line draw the Line D E F; having proceeded thus far, let it be required to make an *Horizontal Dial* to the Latitude of *Durham*, which is 54 Deg. 48 Min. *North*: open your Compasses to the *Chord* of 60 Deg. set one Foot in C, draw the *Arch* A B, and take the *Chord* of 54 Deg. 48 Min. and set it from A to B, and draw the Line C B for the *Style*, so is A C B, the true form and shape of your *Dial-Cock* or *Style*, set one Foot of your Compasses in E, that is where the Line D E F cuts the 12 a-clock Line, and take the nearest distance to the Line C B, or *Style's Height*, turn that point of your Compasses about, and make another mark in the 12 a-clock Line at H; this point H represents the *Center* of the *Equinoctial*. On H as a *Center*, draw the *Quadrant* G E, and divide it into six equal Parts, lay a Ruler to H, and to those equal Parts in the Arch severally, and where the Ruler cuts the Line D E F the Points are through which the *Hour-Lines* must pass, lay a Ruler to the *Center* at C, and to those marks in the Line D E F, and draw the *Hour-Lines*: set off the same distances in the Line D E F, from E towards B, and draw the *Morning Hours*; those before six in the Morning and after six at Night are

CHAP.
IV.

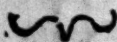
*Example
of an Ho-
rizontal
Dial for
Durham.*

*Of the
Style.*

*Of the
Hour-
Lines.*

pendicular or at right Angles. Note, This is not the 12 a-clock Line in all Dials, tho' it is in the *Horizontal* and *South* and *North Erect Direct* Dials.

CHAP. drawn by continuing the *same Hour Line*
IV. *beyond the Center C.*



How to set it truly.

How to
set it truly.

The Dial being thus finished, the next thing is *to set it truly*, for if it be ever so truly made, and not well set, it will go wrong: therefore you must first see that your Post on which the Dial is to stand be truly level every way: which you may try by your *Quadrant*, on which draw a *Circle* as large as the top of the Post will bear; in the *Center* thereof place a Pin *exactly upright*; in the *Forenoon* when the Sun shineth let the *end of the Shadow* of the Pin touch the *Circle*, where *make a Mark*; let things stand thus till *Afternoon* the same *Day*, and then observe where the *Top* of the Shadow of the Pin toucheth the same *Circle*; there again *make a second Mark*; then divide the distance of these *two Marks* into *two equal Parts*, and from *that* through the *Center* draw a *Line*, which shall be the *12 a-clock Hour Line*, and set the *12 a-clock Line* of your Dial upon this *12 a-clock Line on the Post*; so shall your Dial be truly placed, which may be fastened at your own Discretion.

Note, Instead of the *Quadrant G E*, you may draw a *Semicircle* on the *Center H*,
and

and divide it into 12 *equal Parts*, and so CHAP.
Lines drawn from the *Center* at H will give IV.
the Points in the *Line D E F* as before. ~
Or, if you apply the *Center* of the *Equinoctial Dial* to the *Center* at H, the *Hour Lines* on the *Equinoctial Dial* will cut the *Line D E F* in the Points where the *Hour Lines* on the *Horizontal Dial* must pass.

N. B. *For drawing the half Hours and Quarters upon all Sorts of Dials whatever, you are to observe, that as you divided the Circle which represented the Equinoctial (into 24 equal Parts) for the Hours, so you are to divide each of those Parts into 4 equal Parts more, and those will be the Quarters.*

N. B. *That in placing of Dials when made (excepting the Equinoctial and Horizontal Dial) you have no occasion to regard the Place where they are to be fixed, for the Hour Lines being drawn according to the Declination or Reclination of the Place, it gives you the true Situation of the Dial itself.*





CHAP. V.

To make an erect * direct SOUTH Dial.

Plate 4. Fig. 2.

An erect
direct
South Dial,
what.

THIS Dial Plane is no more than an upright Wall which exactly faces the true South Point. As the Elevation of the Pole above the Horizontal Plane was equal to the Latitude of the Place; so in this it is the Complement of the Latitude of the Place (or what it wants to make it up 90 Degrees).

Upon this Dial, the Sun continues just 12 Hours; that is, from six in the Morning, till six at Night, in all Latitudes.

* 1. Those Planes are said to be erect or upright which stand perpendicular to the Horizon of the Place; and such are the Walls of Churches, Houses, or the like, against which for the most part Dials are placed. 2. Of these erect or upright Planes there are two sorts, viz. Direct and Declining. 3. Those erect or upright Planes are said to be direct which directly face the East, West, North or South Points of the Horizon, and these are called erect direct Planes. 4. Those erect or upright Planes are said to decline, which do not directly face the East, West, North or South Points, but look upon some other Points situate betwixt them, viz. South-East, North-West, North-East, &c. and these Planes are called Upright or Erect, DECLINING Planes. How the Declination is to be found, is taught in Chapter X.

For

Of the erect direct South Dial.

25

For the Hour-Lines.

CHAP.
V.

When you have made choice of your Plane, draw the *Horizontal Line* VI VI, for the *East* and *West* Line, or *Hour Line* of Six; from A let fall the *Perpendicular* A F, for the 12 *a-clock* *Hour Line*; then with your Compasses take 60 *Deg.* from the *Line of Chords*, and draw the *Arch* B C VI; take the *Complement of the Latitude* of your Place (which in this Example I'll suppose to be *Chester*) whose *Latitude* as you find it in the Table is 53 *Deg.* 12 *Min.* *North*, and set 36 *Deg.* 48 *Min.* its *Complement*, or what it wants to make it up 90 *Degrees* from B to C; draw A C for the *height of the Style*. Make choice of any Point at Pleasure, in the 12 *a-clock* *Line*, as I; through I at *right Angles* to the 12 *a-clock* *Line*, draw the *Line* D I E; set one foot of your Compasses in I and take the *nearest distance* to the *height of the Style* A C, and turn that point of your Compasses down to F, and there make a Mark in the 12 *a-clock* *Line*; on which Point F, describe the *Semicircle* G I H, and divide it into 12 *equal Parts* (for that *Semicircle* represents *one Half* of the *Equinoctial*;) lay a Ruler to F, and to those Marks in the *Semicircle* just now made, and draw Lines from thence to the *Line* D I E: Lastly, draw Lines from A to those Marks

How to
draw the
Hour
Lines.

Example
of an
erect di-
rect South
Dial for
Chester.

CHAP. Marks in the Line D I E, and they shall
 V. be the true *Hour-Lines* upon your Dial's
 Plane.

For the Quarters.

The *Quarters* are drawn in like manner, by dividing the *Semicircle* into 48 equal *Parts*, so that one Quarter will be 3 Deg. 45 Min. two Quarters 7 Deg. 30 Min. and three Quarters will be 11 Deg. 15 Min. as you may see by Table III.

Having thus finished the *Hour Lines*, place 12 at the end of the Line A F, and if it is a *South Dial* (as specified above) and your Face toward it, you must place the *Morning Hours* on the left hand, and the *Afternoon Hours* on the right, as you see done in the Figure.

For the Style.

How to
place the
Style.

If your Plane be large, it will be best to get an iron Rod about the *Thicknes* of your *Hour Lines* for the *Style*, and be sure to place it exactly over the 12 a-clock *Hour Line*, and to make an Angle with your Plane equal to the *Complement of Latitude*; which is done by applying the edge of your *Quadrant* to it, and so fix it, when you find it stands true.

For

Of the erect direct North Dial.

27

CHAP.
VI.

For the Thickness of the Style.

☞ Be sure you always mind to make Allowance for the *Thickness of the Rod* which is to be the *Style*, and this is to be done when you draw the *Semicircle G I H* by having *two Centers* at *F* distant *just the Thickness of the Style*; otherwise if this Care be not taken, your Dial will go too *slow* in the *Forenoon*; and too *fast* in the *Afternoon*.

CH A P. VI.

To make an erect direct NORTH Dial.

Plate 4. Fig. 1.

THIS *Dial Plane* is no more than an *Erect direct North* upright Wall that exactly faces the *Dial* true North Point. This Dial is of no use what. from September the 12th, to March the 10th; that is, while the Sun is in the *six Southern Signs* *, to us who inhabit the *Northern He-*

The Six Northern
Signs are,

Aries ♈
Taurus ♉
Gemini ♊
Cancer ♋
Leo ♌
Virgo ♍

* The Six Southern
Signs are,

Libra ♎
Scorpio ♏
Sagittary ♐
Capricorn ♑
Aquarius ♒
Pisces ♓

misphere,

CHAP. *misphere*, because it only shews the Time
 VI. from *Sun rising* to *six* in the *Morning*, and
 in the *Afternoon* from *six* till *Sun setting*; for
 Of no Use *this Dial* and the *South Dial*, make up the
 from 12th *Horizontal Dial*, *i. e.* takes in all the Hours
 September of the *longest Day*; and as the *Style* of the
 till 10th *South Dial* points *downwards*, so of the *North*
 March. the *Style* points *upwards*, and makes an
 Because it *Angle* with the *Plane* equal to the *Comple-*
 only *shews* the *Hours* *ment of the Latitude* of the *Place*, *i. e.* what
 the *Hours* *before six* the *Latitude* of the *Place* wants to make up
 in the *Morning*, 90 Degrees.
 and the *Hours*
 after *six*
 in the *Afternoon*.
 It is made
 after the
 same man-
 ner as the
South Dial.

The making of this, is the very same as
 the *South Dial*, for having made choice of
 your *Plane*, draw the *Horizontal Line* 6,
 A 6, for the *East and West Line*; about the
 middle at A, erect the *perpendicular* A B,
 which shall represent the 12 *a-clock Hour-*
Line, (tho' the Figure 12 needs not be put
 to it).

For the Style's height.

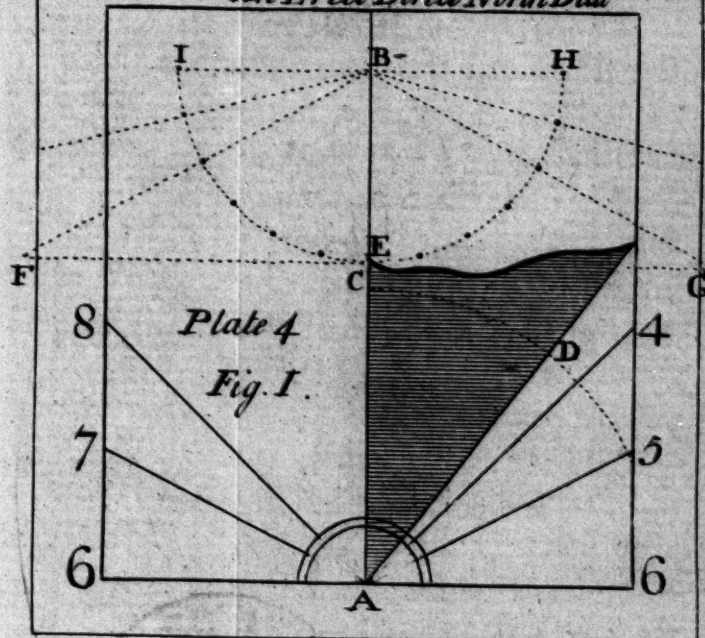
Example
 of an erect
 direct
 North Dial
 for York.

On the Point A, with the *Chord* of 60
 Deg. draw the Arch C D; take from your
 Chords the *Complement of Latitude* of your
 Place, as suppose *York* 36 Deg. 5 Min. and
 set it from C to D; draw A D for the *Style's*
height.

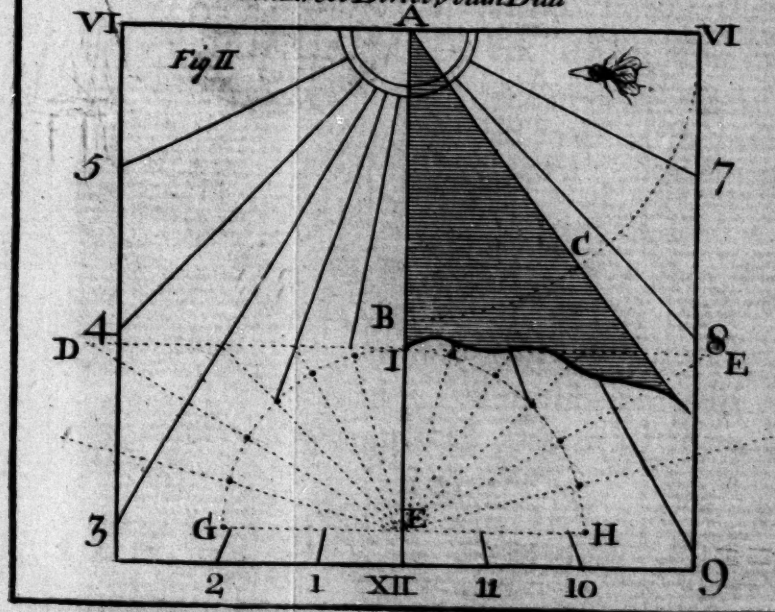
For

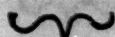
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An Erect Direct North Dial



An Erect Direct South Dial





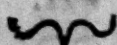
For the Hour Lines.

Make choice of *any Point* convenient for your Purpose, in the 12 a-clock Line A B, as the Point E; thro' which at *right Angles to the 12 a-clock Line*, draw the Line F E G; set one Foot of your Compasses in E, and take the *nearest distance* to the *Style's height* A D; set *that distance* from E to B, so shall the Point B, be the *Center* of the *Equinoctial*; on B with the *distance* B E draw the *Semicircle* H E I, and divide it into 12 *equal Parts*; lay a Ruler to the *Center* B, and to *those Marks* in the *Semicircle*, and where the Ruler cuts the Line F E G are the Places where the *Hour Lines* must pass, which must be drawn from the *Center* A.

On *this Dial* there is not any occasion of drawing any more *Hour Lines*, than 4 and 5 in the *Morning*, and 7 and 8 at *Night*.

Over the 12 a-clock Line A B, at *right Angles*, fix the *Style*; so that it may make an Angle with the Plane, equal to the *Complement of the Latitude of the Place*; which you must try by help of your *Quadrant*, as has been before directed in the *South Dial*; and thus is the *North Dial* compleatly finished.

The *Quarters* and *half Hours* are drawn, as has been taught in *Page 23* and *26*.



C H A P. VII.

To draw an erect direct EAST Dial.

Plate 5. Fig. 1.

An erect
direct East
Dial what.

How long
the Sun
continues
on it.

Of the
Substylar
Line.

How to
draw the
Hour
Lines.

An Ex-
ample of
an erect
direct East
Dial for
Oxford.

THIS Dial's Plane lieth in the Plane of the *Meridian of the Place*, i. e. is no more than an *upright Wall* that exactly faces the *true East Point*: the *Hour Lines* are all *parallel to each other*, and to the *Axis of the World*, and consequently have no *Centers*: the Sun comes on it at his *Rising*, and continues thereon till *near Noon*.

The *six a-clock Hour Line* is the *Substylar Line*, over which the *Style* is fixed at *right Angles*, and may be either a *thin Plat* of Iron, or a *perpendicular Wire*, &c. whose *height* must be equal to the *nine a-clock Hour Line* in this Dial, and to the *three a-clock Hour Line* in the *West Dial*.

Having then made choice of your Plane, *about one third* of the distance from the *bottom*, draw the *Horizontal Line ACH*; in some *convenient Place*, as at C, draw a *Circle* with the *Chord* of 60 *Degrees* sure; then take the *Chord* of the *Latitude of the Place*, as suppose, at *Oxford 51 Deg. 45 Min.* and set from H to P, and draw P C S, which shall be the *Substylar Line*, and
six

Of the erect direct East Dial.

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fix a-clock Hour Line; to which at right CHAP.
Angles draw C D for the Equinoctial. VII.

Next draw the Line A S B, *parallel to*
the *Equinoctial*, and divide the *Quadrant S*
D into *six equal Parts*; lay a Ruler to the
Center at C, and to those *equal Parts* in the
Circle, and it will cut the *Line A B* in the
Points where the *Hour Lines* must pass,
through *which Points* in the *Line A S B*,
draw the *Hour Lines parallel to the fix a-*
clock Hour Line, which are the true *Hour*
Lines from *fix till noon*: the Hours of 4
and 5 in the *Morning*, are the *same distance*
from 6, as 7 and 8 are on the *other side*.

The *Quarters* are drawn by subdividing
the *Divisions* in the *Circle* into *four equal*
Parts, as has been above directed.

Of fixing the Style.

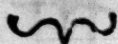
The *Hour Lines* being thus drawn, fix
the *Style* at right Angles on the *Substylar*
Line, as before directed, and your *Dial* is
completely finished.

This *Dial* is universal, by placing the
Earth's *Axis* parallel to the *Axis* of the
World, in what *Latitude* soever you be.

N. B. The Earth's *Axis* in this *Dial* is re-
presented by the *fix a-clock Hour Line*.

See the Description of the Sphere.

CHAP.



To draw an erect direct WEST Dial.

Plate 5. Fig. 2.

A direct
West Dial
what.

THIS Dial Plane is no more than a *upright Wall* that exactly faces the *true West Point*.

The making of this is the very same in all respects as making of the *East Dial*, only as the *East Hour Lines* are elevated to the *right hand*, so here they are elevated to the *left hand*.

Why 12
a-clock
cannot be
shewn by
this Dial.

The Hour of 12 can never come upon either the *East* or *West Dial Planes*, because at that Hour the Sun being upon the *Meridian*, the Shadow of the Style will be *parallel* to the Plane, and consequently can cast no Shadow upon it.

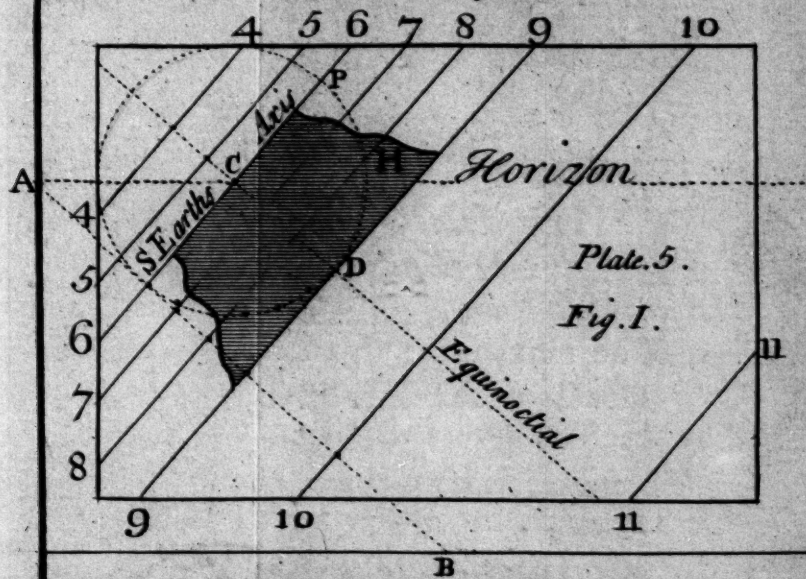
For the Hour Lines and Substylar Line.

How to
draw the
Hour
Lines.

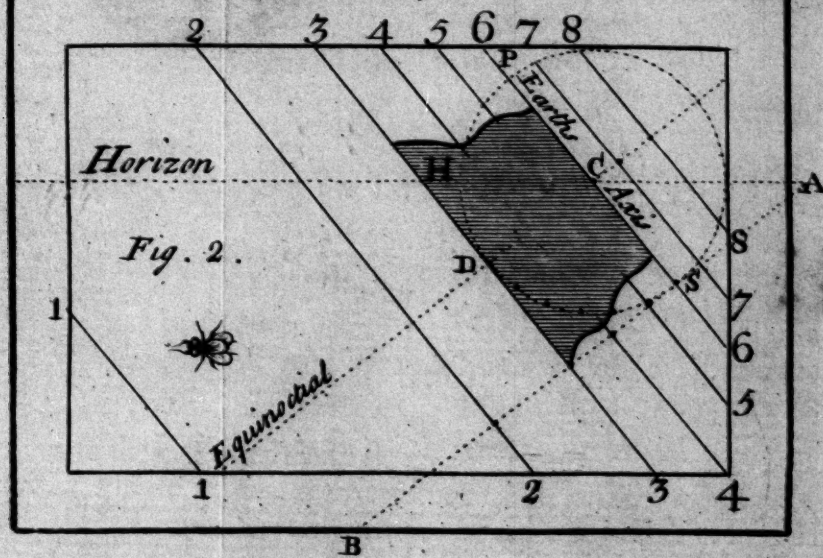
Then, having your Plane in readiness at about *one Third* of the depth of the Plane *from the Top*, draw the *Horizontal Line A H*, and make choice of a *convenient Point* therein, as at *C*, and draw the *Circle P H D S*, take 50 Deg. 44 Min. from your *Line of Chords*, (that being the Latitude of the

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An Erect Direct East Dial

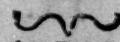


An Erect Direct West Dial



Of the erect direct West Dial.

33

the City of *Exeter*) and set that distance just CHAP. VIII.
now taken from your Line of Chords, from H 
to P, draw P C S for the Substylar Line, and
Hour of Six : [2] And at right Angles thereto, An Ex-ample of a direct West Dial for Exeter.
draw C D to represent the Equinoctial, and
draw the Line B A to touch the Circle in
S parallel to CD. [3] Divide the Quadrant D
S into six equal Parts, and lay a Ruler to the
Center at C and to each Mark in the Qua-
drant D S, and it will cut the Line B A in
the Points where the Hour Lines are to pass :
[4] Through those Marks in the Line B A
draw Lines parallel to the six a-clock Hour
Line, and they shall be the true Hour Lines
upon the Dial. The Hours of 7 and 8 in
the Evening are the same distance from 6,
that 5 and 4 are on the other side.

For the Quarters and Half Hours.

The *Quarters* and *half Hours* are drawn How the Quarters and Half Hours are to be drawn.
in both these *East* and *West* Dials by divid-
ing each *sixth Part* of the *Quadrant D S*
into *four equal Parts*, and carrying them
into the *Line A B*, by laying the *Ruler* to
the *Center C*, and to *those Parts* in the *Arch*
D S, as you were taught in drawing the
Hour Lines.

For fixing the Style.

Fix the *Style* upon the *six a-clock Hour* Of the Stick.
Line, and at right Angles thereto, which
 may

CHAP. may be a Plate of Copper, Brass or Iron,
 IX. (as in Plates 5 and 6) whose height must be
 equal to C D, or the three a-clock Hour Line,
 and then is your Dial finished.

C H A P. IX.

To make a P O L A R Dial.

Plate 6.

A Dial for
 the Island
 of St Tho-
 mas.

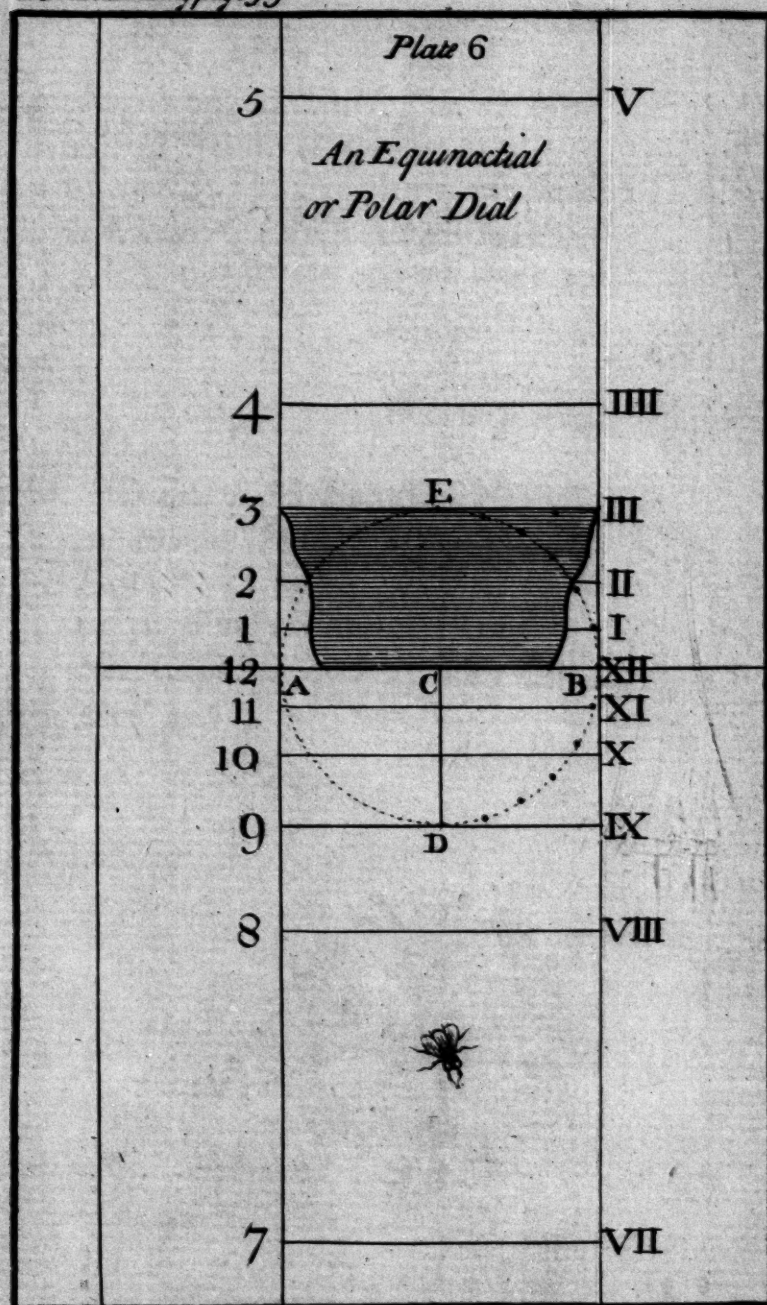
THIS Dial is called by some Authors an *Equinoctial Dial*, and by others a *Polar Dial*; but be that as it will, it is plain, that all Places lying under the *Equinoctial* have no *Latitude*: as for instance the *Island of St Thomas* has no *Latitude*, for which this *Dial* is made; and for that reason the *Hour Lines* cannot have any *Center*, and therefore all the *Hour Lines* drawn upon these *Dials* will be parallel to each other.

For the Hour and Substyler Lines,

How to
 draw the
 Hour
 Lines.

[1] To draw the *Hour Lines* upon this Plane, first draw A B for the *Substyler Line* and *Hour Line* of XII; [2] On C as a *Center* with the *Chord* of 60 Deg. draw the *Circle* A E B D, and draw the *two* Lines V VII, and

to Fold out Facing page 35



Of the Polar Dial.

35

5. 7. divide the Semicircle E B D into 12 equal Parts, lay a Ruler to the Center of the Circle at C, and to each Mark in the Circle, and it will cut the Line V VII in the Points where the Hour Lines must pass : [3] Through which Points draw Hour Lines parallel to A B, and they shall be the true Hour Lines that were required.

CHAP.
IX.

For the Style.

The *Stile* may be a broad Plate of Copper, Brass, or Iron, at Pleasure, placed at right Angles over the 12 a-clock Hour Line.

The Hour Line of six never falls upon this Dial, because under the Equinoctial the Sun rises and sets at Six the Year throughout with very little Variation.



36 *To find the Declination of a Wall.*

CHAP.
X.

C H A P. X.

*To find the Declination * of a Wall
or Plane whereon to draw a Sun-
Dial.*

Plate 7. Fig. 9.

A Description of the Instrument.

[1] **P**ROCURE an oaken Board (which at *London* they call *Wainscot*) about a Foot square, more, or less, it matters not : Take A B C D about an inch thick, well plained on both Sides, and thereon paste a Sheet of good Paper very smooth, on which draw *two* or *three concentric* Circles, (it matters not how many, nor at what distance they be :) [2] In the *Center* I let there be an Hole to receive a *streight Wire* to screw up and down at pleasure, and to stand at *right Angles* to the Board itself; draw *two* Diameters and mark them with the Letters of the four *cardinal Points*, *East*, *West*, *North* and *South*: which *Line N S* represents the *Axis* of the *Wall*, i. e. it stands *perpendicular*, or at *right Angles*, to the *Wall itself*; and if it doth not decline from the *South* or *North*,

See Page 24, Note 4.

nor

To find the Declination of a Wall. 37

nor yet to the *East* or *West*, the said Line CHAP.
also represents the 12 *a-clock Hour-Line*. X.

How to take the Declination.

[3] When you would take the *Declination* of a *Wall*, apply the *Edge* of the Instrument A B to the *Wall*; and in the *Forenoon*, the *Sun* shining, by help of your *Quadrant* place the Instrument parallel with the *Horizon*: screw up your *perpendicular Pin* in the *Center* till the *Shadow* of its *Top* touch any of the *Circles* (it matters not which) as suppose the *utmost* at F; let all Things now rest till *Afternoon*: [4] And then carefully observe where the *Top* of the *Shadow* toucheth the *same Circle* again, which we will suppose at G; thus is your observation finished: [5] Take your Instrument down, and with your *Compasses* divide the *Arch* F G into *two* equal Parts in H; and if from H you draw a *Line* through the *Center*, it shall be a *true 12 a-clock Hour Line*; and N H is the *Declination of the Wall*; which by applying it to the *Line of Chords*, I find to be 14 Deg. And when the Mark last found at H falls on the *East side* of the *Line* N S (as this doth) then is the *Declination* of the *Wall East*, but when the Mark falls on the *West side*, then the *Declination* is *West*.

To make an erect Declining DIAL.

An erect
declining
Dial what.

The *upright* or *erect* Dial Planes already treated of, are such as did *directly* face the *four cardinal* or principal Points of the *Horizon*, viz. *East, West, North, and South* Points. Now ALL OTHER *upright* or *erect* Dial Planes are said to *decline* *, and their *Declination* is counted from the *North* or *South*, towards *East* and *West*, and those Planes are called *South* or *North* erect Planes *declining East* or *West*.

Plate 7. Fig. 2.

Example
of an erect
Declining
Dial for
Liverpool,
Warring-
ton or
Cronton
in Lanca-
shire.

LET it be required to make a Dial in the *Latitude* of 53 Deg. 22 Min. *North*, declining from the *South* to the *West*, 21 Deg. 10 Min.

First,

For the distance of the Substylar Line from the 12 a-clock Hour Line.

How to
find the
Style's di-
stance from
the 12 a-
clock Line.

[1] Draw the *Horizontal Line* A B, and from C let fall *perpendicular* the 12 a-clock Hour Line CD, and from the *Line of Chords*

* See Page 24. Note 4.

take

Of Declining Dials.

39

take 60 *Deg.* with your Compasses, and set CHAP. one foot of the Compasses in C, and draw XI. the Semicircle A D B: [2] And then draw C D at right Angles to A B for the 12 a-clock Line; [3] Take the Complement of the Latitude 36 *Deg.* 38 *Min.* from your Line of Chords, and set it from D to E, and draw E F parallel to A B, so is F E the Sine † of the Arch D E. This done,

[4] Take in your Compasses the Plane's Declination 21 *Deg.* 10 *Min.* from your Line of Chords, and set it from D to G, and draw C G. [5] Take E F in your Compasses, and set it from C to H, draw H I parallel to A B; [6] Take H I, and set from F to L, and draw C L M, now D M measured on your Line of Chords is 15 *Deg.* 2 *Min.* the Substylar Lines distance from the 12 a-clock Line.

Secondly, For the Styles height.

[1] From the Point H, draw the Line H K Of the parallel to C D the 12 a-clock Line; [2] Then height of take H K in your Compasses, and set it from the Style. L to N, and draw C N for the Top of the Style; [3] Then shall M N measured on your Line of Chords be 31 *Deg.* 49 *Min.* the height of the Style.

† The Sine of an Arch is a Line drawn from any Point of the Circumference of a Circle to that Line that passes thro' the Center of the said Circle.

D 4

Thirdly,

CHAP.

XI. Thirdly, For the difference of Inclination *
of Meridians.

Of the
difference
of Inclina-
tion of Me-
ridians.

[1] Set one Foot of your Compasses in M, and take the *nearest distance* to E F. *This distance* set upon the 12 a-clock Line from F to O. [2] Then take the *distance* from O to G, and set it from O to P, [3] Take the *distance* P M in your Compasses, and measure it on your *Line of Chords*, and you will find it to be 25 Deg. 46 Min. the *Inclination of Meridians* sought: This 25 Deg. 46 Min. reduced into Time (by the *Table III.*) is 1 Hour, 43 Min. 4 Seconds, by which I see that the *Substylar Line* will fall *between* the *Hours* of one and two a-clock in the *Afternoon*.

Lastly, For the Hour Lines.

Of the
Hour
Lines.

[1] In any *convenient Place in the Substylar Line* (according to the Largeness of your Dial Plane) as at M, draw the Line R S at *right Angles* to the *Substylar Line* C M, [2] Set one foot of your Compasses in M, and take the *nearest distance* to C N the *Style's height*, [3] One foot resting in M, turn the other to

* See Plate 7. Fig. 1. in which H I represents the 12 a-clock Hour Line in that Place, and N S is the Line that is perpendicular to the Plane; now the Angle that is made between these two Lines at I, is what in Dialling is called the *Inclination of Meridian*.

Of Declining Dials.

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q in the *Substyler Line* upon q as a Center, CHAP. XI.
with the *distance* q M draw the Circle as you
see done in the Dial, which doth represent
the *Equinoctial*. 

[4] Lay a Ruler from its Center at q to D
(that is the Place where the *Line R S* cuts
the 12 *a-clock Hour Line*) and then the
Ruler doth cut the *Equinoctial* in a Point
near O where you are to begin to divide it
into 24 *equal Parts*, which I have here
marked with little *Dots*. [5] Lay a Ruler to
the Center at q, and to every one of the *equal*
Division in the *Equinoctial*, and where the
Ruler cuts the *Line R S*, make these marks
* * * Lastly, draw Lines from the Center
of the Dial at C to these marks * * * in the
Line R S, and those are the true *Hour Lines*
upon the Dial, as was required; to which
place the proper Figures to every Hour, as
you see done in the *Scheme*.

Of the hanging of the Style.

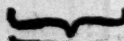
The Style C N must hang directly Square-
wise with the *Substyler Line* C L, and this
you must try with your *Quadrant*, thus;
place that edge of your *Quadrant* upon which
the Sights are, to the Top of the Style, and
when the Thread cuts the Limb of the Qua-
drant in the same Degree with the Latitude
of the Place, then it is right, otherwise it is
wrong.

How the
Style must
hang.

Note,

CHAP.

XI.

 Note, Now you have finished your Dial, and in so doing, you have in the making of this one made four Dials, viz.

	Deg.	Min.
A South Declining East	21	10
A South Declining West		
A North Declining East		
A North Declining West		

The name
of the
Hours and
Place of
the Style
must be
changed.

But you must change the *Names* of the *Hours*, viz. 10 into 2, 9 into 3, 8 into 4, &c †. and place the *Style* on the *contrary Side* of the 12 a-clock Line for the *South declining East*, and by turning the Dial *up-side downwards*, for the *North Decliners*, so that the *Style* may point *upwards* to the *North Pole*, and the Hours about midnight omitted, as your own Reason will soon direct you.

† And here you are to observe that it is *not the Style* that changes its *Place* or *Position*, but the *Plane itself*; for the *Style* answering to the *Latitude of the Place*, it remains *always steady* and the same in *all Declinations*: so that if you conceive a *Plane declining* (as in the *Example* now before us) 21 *Deg.* and 10 *Min.* to the *Westward*, the *Subsylvan Line* falls betwixt the Hours of *One* and *Two* in the *Afternoon*; and supposing the *same Plane* to move to the *Eastward* 21 *Deg.* 10 *Min.* the *Subsylvan Line* will then fall betwixt the Hours of *Ten* and *Eleven* in the *Morning*. For it is an *infallible Rule*, that if the *Plane declines Eastward*, the *Subsylvan Line* falls amongst the *Morning Hours*, but if *Westward* amongst the *Afternoon Hours*.

 Here

Here you are to take notice, that if the Plane decline 60 Deg. or more, then the Hour Lines having Centers will be so near together, and the Style will then be so near the Plane, that one thing will much discom-
mode another, and make it a great difficulty to shew the true Hour of the Day thereby; therefore they ought to be removed far from the Center that they may become wide enough to answer the end of shewing distinctly the true Hour of the Day.

How to proceed if the Plane declines 60 Deg. or more.

But still here will arise a Difficulty in dividing the Circle, which represents the Equinoctial, for there will be required the Difference of the Inclination of Meridians of the Plane and Place, for this Purpose I have added Table V. for the Latitude of London, shewing the Style's height, Substyle's distance from the Meridian, and difference of Inclination of Meridians, which tho' calculated indeed for the Latitude of London, (viz. 51 Deg. 32 Min.) yet may serve indifferently for most Places in England; but he that wants to be more curious and exact, may, by observing the Directions given in the beginning of this Chapter for finding the three Requisites, (by that means) obtain those Requisites for any Place in the known World.

A Table at the end of the Book for avoiding the Difficulty of dividing the Equinoctial.

Of a great Declining Dial.

C H A P. XII.

To make a Dial upon a Plane when the Pole has but a small Elevation above the Plane.

Plate 8. Fig. 1.

I Shall take for an *Example* a Dial that I made at *London*, whose Plane declined from the *South* by the *East*, northerly 100 Deg. 16 Min. that is 79 Deg. 44 Min. from the *North* towards the *East*.

For the Style's height.

Of the
height of
the Style.

☞ The *Style's height* you will find by *Construction*, as in Chap. X. or by *Table V.* to be 6 Deg. 22 Min. the *Substyle's distance* from the *Meridian*, 38 Deg. 1 Min. the *Inclination of Meridians*, 81 Deg. 56 Min.

[1] Let the *Square* A B C D represent the Plane, because 'tis a *North Plane declining Eastward*, therefore the *Style* must point upwards, and the *Center of the Hour Lines* will be *some where below* the Plane itself. And therefore take 60 *Degrees* from your *Line of Chords*. Set one Foot of your *Compasses* at the *bottom Corner* of the Plane at C, and draw the *Quadrant* E F. [2] Take 38 Deg. 1 Min.

Of a great Declining Dial.

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1 Min. from your *Line of Chords*, (the Sub-
style's distance from the 12 *a-clock Line*)
 and set it from F to G, then draw C G con-
 tinued for the *Substylar Line*. [3] Take 6 Deg.
 22 Min. the *Style's* height from your *Line of*
Chords, and set it from G to H, and draw C
 H for the *Style*: [4] Now, because the *Style*
 has but *small height*, draw an *other Line* I
 K *parallel* to the *Style* of the *Dial*, at such
convenient distance as in your judgment will
 best fit the *Dial Plane*, viz. that all the
Hour Lines may fall thereon, so shall that
 Line I K be the *enlarged Style* of the *Dial*.

CHAP.
XII.

For the Hour Lines.

[5] Now by the *Substylar Line*, and this
enlarged Style, the *Hour Lines* may be drawn
 (at *convenient* distances) without any regard
 had to the *Center* of the *Dial*.

How the
Hour
Lines may
be drawn.

And to do that, assume any *two Points* in
 the *Substylar Line* C G, at some *convenient*
 distance from each other, as L and M, and
 through those *two Points* draw *two streight*
Lines, both of them at *right Angles* to the
Substylar Line C G, as the *Lines* N L O
 and P M Q, [6] Set one foot of the *Compasses*
 in L, and take the *nearest* distance to the
enlarged Style I K, and turn that foot from
 the *Style* to R; on R as a *Center* with the
 distance L R draw a *Semicircle*, set one
 foot of the *Compasses* in M, and take the

nearest

CHAP. *nearest distance to the enlarged Style I K,*
 XII. *and turn that foot from the Style to S; on*
 S, as a Center, draw a Semicircle.

[7] Take the Plane's *Inclination of Meridians*, 81 Deg. 56 Min. and set from L to T, and from M to V upon the Semicircles. Then

[8] Divide *each Semicircle* into 12 equal Parts, beginning at T and V; lay a Ruler to the Centers R and S *severally*, and to the Marks just now made in the Semicircles, and the Ruler will then cut the Lines P M Q and N L O in the true Places where the *Hour Lines* must be drawn.

Lastly, Lay a Ruler to *those Marks* in the Lines P M Q and N L O, and draw *right Lines* through the Plane, and they shall be the *true Hour Lines* required, and will be removed far enough from the Center, and that will shew distinctly the Hour of the Day.

For the Style.

The Style
to stand at
right
Angles.

The Style must stand at *right Angles* upon the *Substylar Line I K*.

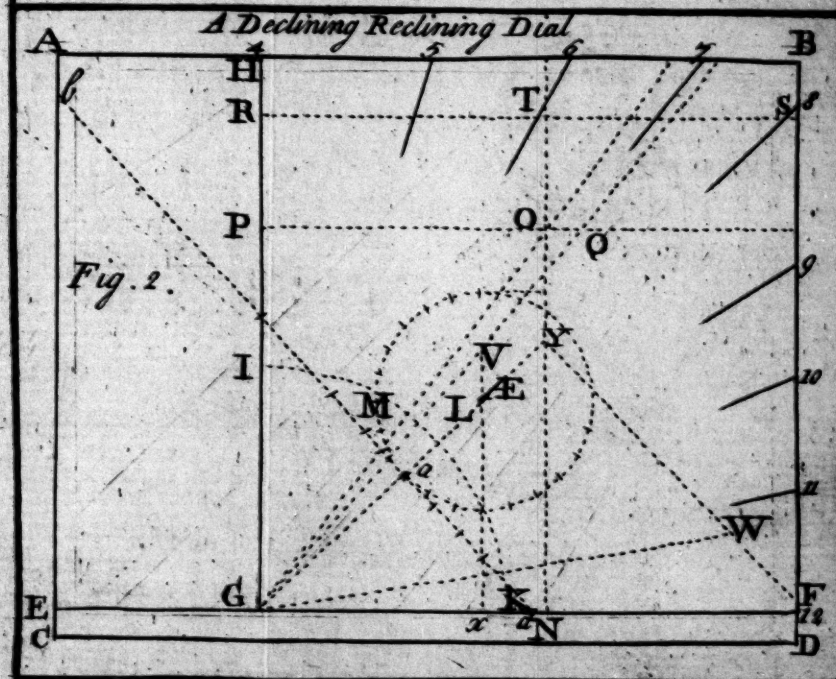
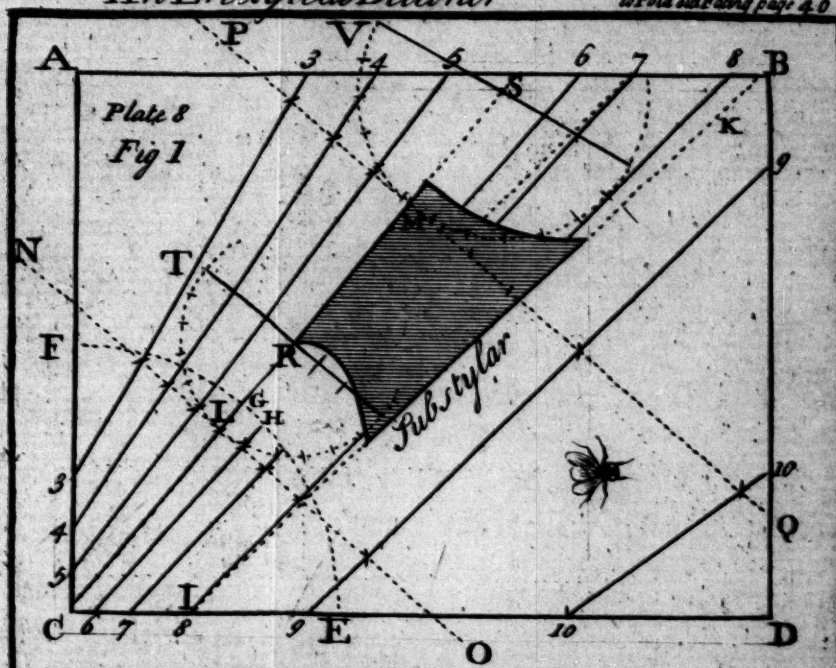
For the Quarters.

The Quar-
ters of
Hours
how
drawn.

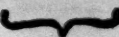
The *Quarters* are drawn by dividing *each* of the 12 equal Parts in the Semicircles into *four equal Parts more*, and from *those Divisions*

An Ered great Decliner

To Fold out Facing page 4.6



Of Declining Reclining Dials. 47

vifions draw Lines, as has been taught above **CHAP.**
for drawing the *Hour Lines*, and your Dial **XIII.**
is finished. 

C H A P. XIII.

*To make a declining reclining * DIAL.*

Plate 8. Fig. 2.

SUCH Planes as do directly face the *Of South*
South or *North Points* of the *Horizon*, and *North*
but do *recline* (or fall backwards) from the *reclining*
Zenith (like the Roof of a House) towards *Planes.*
the *South* or *North* are called *South* or *North*
Direct Planes *reclining* so many *Degrees*
as the *Reclination* is ; and the Number of
Degrees that the Plane *reclines*, may be
found by applying the *edge* of your *Qua-*
drant, in which the *Sights* are placed to
the *Plane*, and the *Thread* will cut the *Limb*
in the Number of *Degrees* that the Plane *re-*
clines, which being a Thing so plain, I need
not give any Example.

And of *reclining Planes* there are Six Va- *Six differ-*
rieties, *three* of *South*, and *three* of *North* *rent Sorts*
of reclining
Planes,

* Those *Dial Planes* that *lean from you* when you stand *viz. 3*
before them, are called *reclining Planes*, because they *recline North and*
from the Zenith. *3 South.*

Recliners,

CHAP. Recliners, all which may be reduced to new
 XIII. Latitudes, wherein they will become *Horizontal Planes*, and consequently Dials may be made as has been taught, Chap. IV. where I have shewn how to draw *Hour Lines* upon an *Horizontal Plane*.

First of Direct South Recliners.

The 1st
 Variety in-
 stanced in
 a South re-
 clining
 Dial for
 Cam-
 bridge.

First Variety: Let there be a *direct South Plane* in the *Latitude* of *Cambridge*, which is 52 Deg. 17 Min. which *reclines* from the *Zenith* thereof 26 Degrees; in what *Latitude* will that be an *Horizontal Plane*?

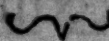
Now, because the *Reclination* is less than the *Complement* of the *Latitude* 37 Deg. 43 Min. *Subtract* the *Planes Reclination* 26 Deg. from the *Complement* of the *Latitude* 37 Deg. 43 Min. and the *Remainder* 11 Deg. 43 Min. is the *new Latitude* in which it becomes an *Horizontal Plane*.

The Operation.

	Deg.	Min.
The Complement of the Latitude at Cambridge is	—	—
	37	43
The Plane's Reclination there (which subtract) is	—	—
	26	00
The new Latitude is	—	—
	11	43

Declining Reclining *Dials*.

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So that an *Horizontal Dial* made for the CHAP.
Latitude of 11 Deg. 43 Min. shall be a *South XIII.*
Recliner 26 Degrees in the *Latitude* of 
Cambridge.

Second Variety. If the *Reclination* of the ^{2d Variety.}
Plane be equal to the *Complement* of the *La-*
titude of the *Place*, the *new Latitude* is no-
thing, that is, neither *Pole* has any *Eleva-*
tion above such a *Plane*, and the *Hour Lines*
 are all *parallel*, and the *Style* is likewise *pa-*
rallel to the *Plane* itself; and therefore, a
Dial for such a *Plane* must be made in *all*
respects, as has been shewn *Chap. IX. Plate 6.*

So that admit at *Lincoln*, where the *Latitude* is 53 Deg. 15 Min. a *South Plane* Instanced
in a South
reclining
Dial for
Lincoln.
reclines from the *Zenith* 36 Deg. 45 Min.
 (which is equal to the *Complement* of the *La-*
titude of that *City*) I say, it becomes an *Ho-*
orizontal Dial under the *Equinoctial*, as ap-
 pears by the *Operation*.

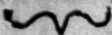
The Operation.

	Deg.	Min.
The <i>Complement</i> of the <i>Latitude</i>		
at <i>Lincoln</i> is	—	—
	36	45
The <i>Plane's Reclination</i> there		
(which <i>subtract</i>) is	—	—
	36	45
So you see the <i>new Latitude</i> is	—	00 00

E

In

CHAP. In Plate 6. you have the Dial that is for
XIII. this Purpose.

 *Third Variety.* If the *Reclination* of the
3d Variety. Plane exceeds the *Complement of the Latitude*
of the Place, then *subtract* the *Complement*
of the *Latitude* from the *Plane's Reclination*,
and the *Remainder* is the *new Latitude*,
where it will become an *Horizontal Plane*.

Example.

Instanced Suppose at *Norwich*, whose *Latitude* is
in a South 52 Deg. 43 Min. a direct South Plane re-
reclining reclining 56 Deg. from the *Zenith*, where will
Dial for that be an *Horizontal Dial*?
Norwich.

The Operation.

	Deg.	Min.
The Plane's Reclination	56	00
Complement of the Latitude of Norwich (which subtract) —	37	17
The New Latitude is	18	43

So that an *Horizontal Dial* made for the
Latitude of 18 Deg. 43 Min. will be a *direct*
South reclining Dial from the *Zenith* of *Nor-*
wich 56 Degrees.

Secondly,

Declining Reclining Dials.

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CHAP.
XIII.

Secondly, Of direct NORTH Recliners.

First Variety. If the Reclination be less than the Complement of the Latitude of the Place, add them together, and that is the new Latitude where such Recliner will become an Horizontal Plane.

Example.

Suppose at Newcastle upon Tyne, whose Latitude is 54 Deg. 57 Min. a direct North Plane should recline from the Zenith 29 Deg. how must the Hour Lines be drawn thereon?

Instanced
in a North
reclining
Dial for
Newcastle
upon Tyne.

To the Complement of the Latitude of Newcastle upon Tyne, 35 Deg. 3 Min. add the Plane's Reclination 29 Deg. and their Sum is 64 Deg. 3 Min. and that is the new Latitude, for which Place make an Horizontal Dial, as has been before taught, and that will be a North reclining Dial at the Place above-mentioned.

The Operation.

	Deg.	Min.
The Complement of the Latitude at Newcastle upon Tyne is	—	35 03
The Plane's Reclination there (which add) is	—	— 29 00
The new Latitude	—	— 64 03
E 2		Second

CHAP. *Second Variety.* If the *direct North Plane*
 XIII. *recline equal to the Latitude of the Place,*
 add it to the *Complement of the Latitude,*
 2d Variety. and *that Sum* will always be *90 Deg.* so
 that *under the Pole* it becomes an *Horizontal Dial*; make a Dial as has been taught
 in *Chap. III. Plate 3. Fig. 1.* by dividing a
Circle into 24 equal Parts, and fixing a
Wire perpendicular in the Center, and it is
 done.

Example.

Instanced Suppose at *Wrexham* in *Denbighshire,*
 in a North whose Latitude is *53 Deg. 6 Min.* a *direct*
 reclining North Plane reclines *53 Deg. 6 Min.* I de-
 Dial for Wrexham. sire to know *where* this will become an *Ho-*
rizontal Plane?

The Operation.

			Deg.	Min.
The Complement of the Latitude				
at <i>Wrexham</i> is	—	—	36	54
The Plane's Reclination there				
(which add) is	—	—	53	06
The new Latitude is	—	—	90	00

3d Variety. *Lastly.* If the Plane's Reclination exceed
 the Complement of the Latitude of the Place,
 add them together, and *that Sum* is the

Declining Reclining *Dials*.

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new Latitude where *such a Plane* will become an *Horizontal Plane*. CHAP. XIII.

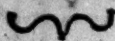
But note, if the *Sum* exceed 90 *Deg.* take the *Complement* thereof to a *Semicircle*, or 180 *Deg.* and the *Remainder* is the *new Latitude*, where *such a Reclining Plane* will become *Horizontal*.

Example.

Suppose at *Shrewsbury*, whose *Latitude* is 52 *Deg.* 44 *Min.* a *direct North Plane* *reclines* from the *Zenith* 60 *Deg.* where will it become an *Horizontal Plane*?

Instanced in a North Reclining Dial for Shrewsbury.

To the *Complement* of the *Latitude* of the *Place* 37 *Deg.* 16 *Min.* add the *Plane's Reclination* 60 *Deg.* and their *Sum* is 97 *Deg.* 16 *Min.* whose *Complement* to 180 *Deg.* is 82 *Deg.* 44 *Min.* in which *Latitude* such a *Plane* at *Shrewsbury* will become *Horizontal*; therefore draw *Hour Lines* thereon, as you have been taught in making the *Horizontal Dial*, and they will be the true *Hour Lines* for that *Plane* and *Place*, as just now mentioned.



The Operation.

	Deg.	Min.
The Complement of Latitude at Shrewsbury is — —	37	16
The Plane's Reclination there (which add) is — —	60	00
The Sum (which is to be sub- tracted from the Semicircle) —	97	16
A Semicircle is (180 Degrees) —	180	00
The Sum as above to be sub- tracted — —	97	16
The new Latitude — —	83	44

Note, That in making of any of these North or South reclining Dials, you have also made (at the same Time) a direct North or South inclining Dial from the Zenith, 26 Deg.

As in the first Variety for Cambridge, you have made also a North Dial inclining to the Horizon 26 Deg. either by drawing of the Hour Lines and Style through the Center, or by turning the reclining Dial about, upon the Hour Line of Six; and then as the North Pole is raised or elevated upon the South Recliner, so much will the South Pole be raised or elevated above the North Incliner.

C H A P. XIV.

To make an East or West RECLIN-
ING * Dial.

AS all North and South reclining Dial Planes, were reduced to new Latitudes, wherein they would become Horizontal Planes; and thereby made by the Directions given in Chap. IV. so all DIRECT East or West Reclining Dial Planes in any Latitude, may be reduced to erect or upright DECLINING Planes in another Latitude, and therefore may be made by the Directions in Chap. XI. of this Treatise; yet I shall here shew, for the young Tyro's Improvement, how they may be done mechanically, without any such Alteration. But first, to reduce them to new Latitudes.

* As in upright or erect Dial Planes there were two Sorts or Varieties, viz. Erect direct and erect Declining; so there are two Sorts or Varieties of Reclining Dial Planes likewise: For such Reclining Planes as do directly face either the true East, West, North, or South Points of the Heavens are called DIRECT Reclining Planes.

Again, those Reclining Planes which do not directly face the said Cardinal Points, but deviate therefrom, i. e. face some other Points situate between them, as South-East, North-West, North-East, &c. are called DECLINING Reclining Planes, and the manner of drawing the Hour Lines upon these Direct and Declining Reclining Planes, affords a much greater Variety than there was in the erect or upright Planes. See Page 24.



The Rule.

The Complement of the *known Latitude* or *Latitude you are in*, is always the *new Latitude*, and the Complement of the *Reclination* * is always the *Declination* in that *new Latitude*, in which it will become an *erect declining Plane*.

And before I proceed any further, it is proper to inform you how you shall know whether the *North* or *South Pole* is *elevated* above any given Plane.

Of the
Elevation
of the
Pole in
Horizon-
tal Dials.

[1] All *Horizontal Planes* in *North Latitude* have the *North Pole* elevated; but all *Horizontal Planes* in the *South Latitude* have the *South Pole* elevated.

Of the E-
levation
of the Pole
in erect
direct or
declining
Dials.

[2] Upon all *erect Planes* whether *direct* or *declining*, if it face the *South*, the *South Pole* is elevated; but if it face the *North*, the *North Pole* is elevated, as you may the better perceive by viewing the *erect direct North* and *South Dials* in *Plate 11*.

Of the E-
levation of
the Pole in
direct East
and West
Recliners
and In-
cliners.

[3] Upon all *direct East* and *West Planes* (let them recline ever so far) the *North Pole* is elevated; but on their *opposite Incliners* the *South Pole*.

* The *Reclination* of a Plane is the Quantity of *Degrees* which any Plane, on which a Dial is supposed to be drawn, lies or falls back from the *truly erect* or *upright Plane*.

[4] Over

Of East or West Reclining Dials. 57

[4] Over all North reclining Planes, whether direct or declining the North Pole is elevated, and over the opposite Incliners the South Pole.

Lastly. Over all South reclining direct or declining, if the Plane pass between the Zenith and the Pole, the South Pole is elevated, as in the North Pole on their opposite Incliners, and if the Plane lie between the Pole and the Horizon, the North Pole is elevated; but the South over their opposite Incliners.

Now let it be required to make an East Dial for Worcester, to recline 40 Degrees;

According to the former Method of reducing it to new Latitudes, it will be an erect Dial in Latitude 37 Deg. 46 Min. (that being the Complement of the Latitude of Worcester) declining from the South Eastward 50 Degrees, that being the Complement of the Plane's Reclination. So that if by the Directions in the XIth Chapter, you make an erect Dial for 37 Deg. 46 Min. North Latitude, declining 50 Deg. South East, it will be an East Recliner 40 Deg. from the Zenith, in the Latitude of 52 Deg. 14 Min. However I shall here shew how to do it mechanically.

First. You must consider, that the East and West RECLINERS have their Center near the Bottom of the Plane, but the INCLINERS of both sorts have their Centers

CHAP.
XIV.

Of the Elevation of the Pole in North Recliners and Incliners.
Of the Elevation of the Pole in South Recliners and Incliners.

Example of an East reclining Dial for Worcester.



Centers near the Top: And the *East INCLINER* and *West RECLINER* must have their *Centers towards the right Hand*; but the *East RECLINER* and *West INCLINER* have their *Centers towards the left Hand*.

These things being *well understood*, I shall now proceed to practice.

Having made choice of your *Plane*, as suppose A B C D. *Plate 8. Fig. 2.*

For the Substylar Line and Style's height.

According to the foregoing Directions, I observe that the *Center of this Dial* must be at the *Bottom towards the left Hand*: therefore [1] at the *Bottom of the Plane*, draw the *Line E F* for the *12 a-clock Line*, in which make choice of some *convenient Place*, as at G; [2] chuse G for the *Center of the Dial*, and from G draw G H at *right Angles* to E F. [3] Then with one foot of the *Compasses* in G, describe the *Quadrant I K*, and by the help of your *Line of Chords*, set off the *Plane's Reclination 40 Deg.* from I to L, and draw the *Line G L as long as you can*. [4] Also set off from I to M the *Complement of the Latitude of the Place 37 Deg. 46 Min.* and draw the *Line G M as long as you can*; [5] then in *any Point at Pleasure* in the *12 a-clock Line E F*, chuse a *Point*

a Point as N, and from that Point draw a CHAP. XIV.
Line parallel to G H, as N O; and through the Point where it cuts the Line G M, draw P O parallel to E F; [6] take G Q in your Compasses, and set it from G to R, and draw R S parallel to the Meridian E F, and it will cut N O, in T; [7] set the Distance P Q from G to V, and draw V X parallel to T N; [8] take in your Compasses G X, and set it from T to Y, and draw G Y for the Substyle; [9] from Y erect the perpendicular Y W, take V X in your Compasses, and set it from Y to W, and draw G W for the Style: The Triangle G Y W, representing the Style of your Dial, which being erected perpendicular to the Plane, upon the Substyle G Y, shall give the Hour by the Shadow of its upper edge.

For the Hour Lines.

[1] Chuse a Point at Pleasure in the Substyle G Y, as at *a*; through that, at right Angles thereto, draw the Line *b a*, as long as you can; set one foot of the Compasses in *a*, viz. the Point where the Line *b a* cuts the Substyle, and take the nearest distance to the Style's height; let one foot rest in *a*, and turn the other to $\text{\AA}$ in the Substyle, and on $\text{\AA}$ as a Center describe the Semicircle (or a whole Circle if you please). [2] Lay a Ruler to the Center of the Circle at $\text{\AA}$, and to *d*, that

60 Of East or West Reclining Dials.

CHAP. that is, where the *Line b a* cuts the 12 *a-*
XIV. clock *Line G F*, and where the Ruler cuts
 the *Circle*, there you are to begin to divide
it into 24 *equal Parts*: a Ruler laid to *Æ*,
and to the *equal Parts* in the *Circle*, will
cut the *Line b a* into *unequal Parts*, where
make *Marks * * ** Lastly. A Ruler laid to
the *Center* of the Dial at *G*, and to those
*Marks * * ** in the *Line b a* will be the
true *Hour Lines* required.

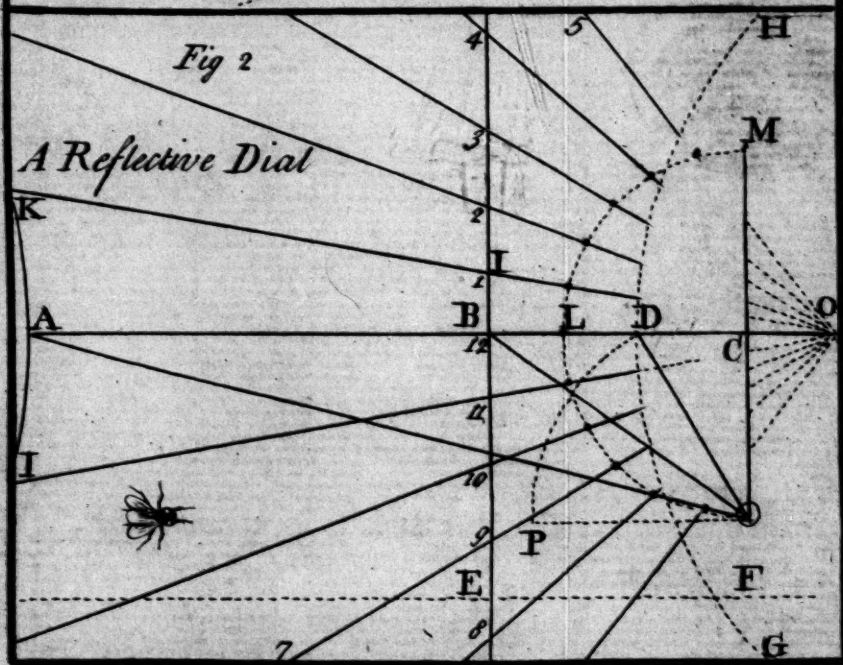
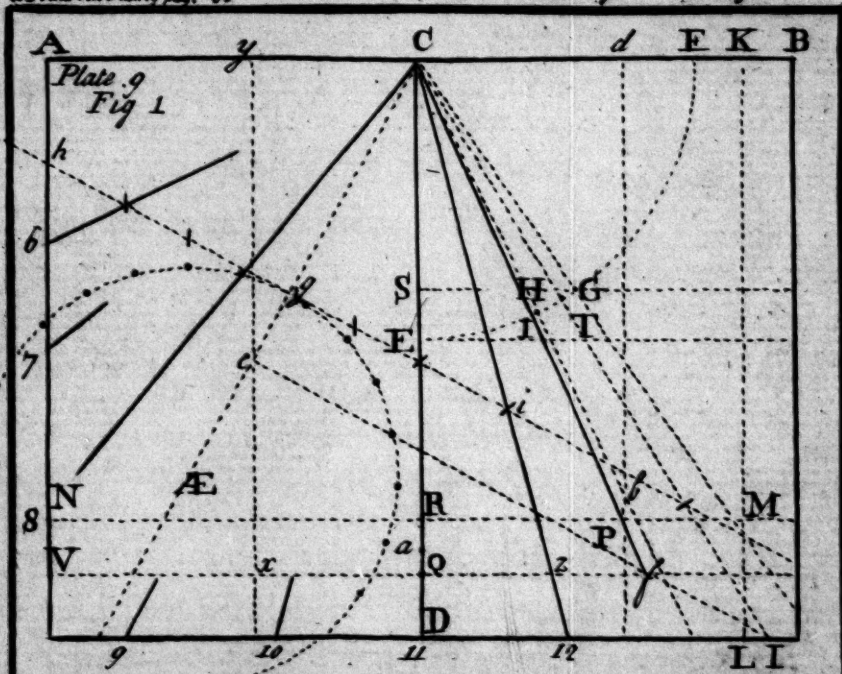
The *Line G F* being the 12 *a-clock Line*,
you must place 12 at the *end*, as you see in
the *Figure*, and the rest 11. 10. 9. 8. 7. 6.
and then your Dial is finished.

N. B. In drawing *this* Dial, you have
made *three more*; for if it is *turned upside*
down, then it is a *West Dial inclining 40*
Degrees, with *this Alteration only*, that
where 11 *now* stands you must place 1, and
2 where 10 is, &c. and consequently the *Sub-*
style will then be as much on the *right Hand*,
as it is *now* on the *left*.

If it were drawn upon *oyled Paper*, the
back-side would be a *West Dial, reclining 40*
Deg. only the Figures 12. 10. 9. &c. must
be 1. 2. 3. &c.

Lastly, If the 12 *a-clock Line G F* be
turned upwards, the *back-side* will be an
East Dial inclining 40 Deg. and the Figures
must remain just as they are; only the *Sub-*
style must be as far to the *left Hand* of the
Perpendicular G H, as it is *now* on the *right*.

C H A P.



C H A P. XV.

To make a North or South Declining
* Reclining or Inclining Dial.

Plate 9. Fig. 1.

THESE Dial Planes cannot be re-duced to new Latitudes without the help of Trigonometry, therefore I shall proceed Mechanically. *Not reducible to new Latitudes.*

Take for an *Example* a Plane at *Edinburgh*, declining from the *South* to the *East* 30 Deg. and reclining from the *Zenith* 25 Deg.

First for the Style.

[1] Draw the *Horizontal Line* A B; [2] *How the Style is found.* make choice of any convenient Place in the Line A B, as C, for a *Center*, and draw C D. [3] With your *Line of Chords* of 60 Deg. draw the *Quadrant* E F. [4] Take the *Complement of the Latitude of Edinburgh* 33 Deg. 53 Min. from your *Line of Chords*, and set it from E to G, and draw the Line C G

* Those Dial Planes that lean towards you when you stand before them are called *Inclining*, and those that lean from you are called *Reclining*; and

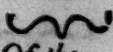
Declining, *Reclining* or *Inclining* Dials, are those whose Planes neither face directly any of the four *Cardinal Points*; nor are they either *perpendicular* or *parallel* to the *Horizon*.

62 Of North and South Reclining Dials.

CHAP. *as long as you can.* [5] Take the Plane's
 XV. *Declination 30 Deg.* from your *Line of*
 ~~~~~ *Chords*, and set it from E to H, and draw  
 the Line CH, *as long as you can.* [6] Take  
 the *Inclination of the Plane 25 Deg.* from  
 your *Line of Chords*, and set it from E to I,  
 and draw the Line CI *as long as you can.*  
 [7] Make choice of a Point in the Line AB  
 as K, and draw KL *parallel* to CD,  
 and it cuts the Line CG (*the Complement of*  
*the Latitude*) in M, and thro' that *crossing*  
 draw MN *parallel* to AB, and it *cuts* the  
*Line of Inclination* CI in P. [8] Take CP,  
 and set it from C to Q, draw QV *parallel* to  
 AB: [9] Take RP in your Compasses,  
 and set it from C to S, and draw SH *pa-*  
*rallel* to AB, to cut the *Line of Declination*  
 CH in H: [10] Take CK in your Com-  
 passes, and set it upon the *Line of Declination*  
 from C to T, and draw ET *parallel* to A  
 B: [11] Take ET in your Compasses, and  
 set it from Q to X, and draw XY *parallel* to  
 CD. [12] Now take in your Compasses the  
*distance* SH (that is from CD to the *Line*  
*of Declination*) and set it from Q to Z, and  
 draw CZ for the *Meridian Line*, or *Hour Line*  
 of 12. [13] Take in your Compasses the  
*distance* CS, place *one Foot* in E, and make  
 a Mark where the *other Foot* falls at *a*.  
 [14] Take Ca, and set it from C to *b* up-  
 on the *Line of Inclination*, and draw *b d pa-*  
*rallel* to CD; [15] take in your Compasses  
 Cd,



## Of North and South Reclining Dials. 63

C *d*, carry *that* extent, and set *one* Foot of CHAP.  
the Compasses in X, and the *other* will give XV.  
*e*, draw C *e* for the *Substyle*, from *e* erect   
the *Perpendicular e f*. [16] Take *b d*, and Of the  
set it from *e* to *f*, and draw the Line C *f* for Substylar  
the *Style*, so shall the *Triangle C e f* be the Line.  
*Style* to be erected *Perpendicular* to the  
Line C *e* the *Substyle*. The Side C *f*, be-  
ing *parallel* to the *Axis* of the World, and  
by its *Shadow* is determined the *Hour of the*  
*Day*.

### For the Hour Lines.

[1] Chuse a Point in the *Substyle* C *e*, as How to  
*g*, thro' which Point, and at *right Angles* to draw the  
the *Substyle*, draw the Line *g b*. [2] Set Hour  
*one* Foot of the Compasses in *g*, and take Lines.  
the *nearest Distance* to the Line C *f*, and  
turn *that* Foot about to *Æ*; upon *Æ* with  
the *Distance* *Æ g*, draw the *Equinoctial*  
*Circle*, or so much of it as will suffice to  
bring the *Hour Lines* upon the Plane that  
you have occasion for: [3] Lay a Ruler  
to the *Center* at *Æ*, and to *i*, that is, where  
the Line *b i* cuts the *Meridian* or 12 *a-clock*  
*Line*, and there begin to divide the *Equi-*  
*noctial Circle* into 24 *equal Parts*; a Ruler  
laid to *Æ* and to those *equal Parts*, will di-  
vide the Line *b i b* *unequally*, and give the  
*Places* thro' which the *Hour Lines* must  
pass: *Lastly*. Lines drawn from the *Center*

## 64 Of North and South Reclining Dials.

CHAP. of the Dial at C, thro' those *Marks* in the  
 XV. Line *bi*, shall be the *true Hour Lines* of  
 that Dial; which *Number* as you see done  
 in the Figure.

Note, You may draw your Dial with  
 Charcoal or Black Lead (*that is, the*  
*Preparative Work*) *that it may be taken*  
*out when you have put on the Hour-*  
*Lines, so that nothing may appear but*  
*what is really useful.*

All other *Declining Reclining* Dials are  
 made by the *same Directions* that are given  
 in this above, only by changing the *Fi-*  
*gures, &c.*

Of an In-  
 cliner De-  
 clining  
 from the  
 South  
 Westward.

As Secondly. The *Incliner, Declining* from  
 the *South Westward*, is made by the *same*  
*Directions*, only the *Quadrant* must be  
 drawn on the *other side* towards A, which  
 may be best conceived by supposing *this*  
 Dial to be drawn on oyled Paper; and look-  
 ing thro' the Paper, that which on the right  
 side of the Paper was an *Inclining* Dial,  
*Declining* from the *South Eastward*, will  
 be an *Inclining* Dial, *Declining* from the  
*South Westward*.

Of a  
 North  
 Declining  
 East Re-  
 cliner.

Thirdly, A *North Declining East Recliner*  
 is the same with a *South Decliner East, Re-*  
*clining* from the *Zenith*, only the *Horizon-*  
*tal Line* must be at the *Bottom* of the Dial;  
 and also the *Center* of the *Quadrant* (and  
*Hour*



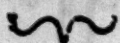
Of North and South Reclining Dials. 65

*Hour Lines*) must be *above* the Line A B, and towards the *left Hand*, and may be represented by a *South Declining East* Recliner, turned *Bottom* upwards, with the *same side* towards you as before. CHAP. XV.

*Fourthly.* A *North Declining West* Recliner is the same with a *South Declining West* Incliner, only (as before) the *Horizontal Line* A B, must be at the *Bottom* together with the *Center* of the Dial, and the *Quadrant* must be *above the Line*, and towards the *right Hand*, and may be represented by the Dial already described, if imagined to be done upon *oyled Paper*, and seen thro', being turned *Bottom upwards*. *Of a North Declining West Recliner.*

N. B. *The Hours on the North Dials must be numbered the contrary way to those of the South Dials.*





## C H A P. XVI.

To make a REFLECTIVE \* Dial.

Plate 9. Fig. 2.

THIS Dial will shew the true Hour of the Day by *Reflection* on a *Cieling*, where the *direct* Beams of the Sun can never come, and it will represent the *Sun's Motion*, as truly and regularly *within the House*, as his natural Motion is *without*, provided the *Window* open to the *Southward*, or so that the Sun might shine in or near it.

The Ground  
or Founda-  
tion of Re-  
flective  
Dials.

These sorts of Dials are grounded upon this Principle in *Opticks*, viz. *that the Angle of INCIDENCE is equal to the Angle of REFLECTION*: that is, whatever height the Sun be at any time, the *same height* has the *reflected Spot* upon the *Cieling*.

This being understood, it is easy to draw *Hour Lines* upon the *Cieling* of a Room, or upon any other Place though never so Irregular, and that the *Hour* by the help of a *Piece* of a *Looking-Glass* fixt *Horizon-*

\* *Reflective* or *reflecting* Dials, are made by a little piece of *Looking-Glass* duly placed, which reflect the *Sun's Rays* to the top of a *Ceiling* where the Dial is drawn. *N. B.* The Piece of *Glass* should be as thin as it can well be ground.

tally



tally in a *Window*, or some other convenient Place for that Purpose, may be truly known.

CHAP.  
XVI.

To place the Glass.

[1] Having then made choice of a *Window* towards the *South*, that so you may have as much of the *Morning* and *Afternoon* *Sun* as possible, take special care to fix your Glass *Horizontal*, otherwise your Work will all be spoiled.

N. B. All Great Circles, as *Equinoctial* and *Hour* Circles, are *streight Lines*, and the lesser Circles as *Tropicks* and other *Parallels* of the *Sun's Declination* are † *Conick Sections*: and that this Dial (when drawn) is no other than a *Horizontal Dial* for the same *Latitude* inverted, Plate 9. Fig. 2.

Great Circles of the Sphere are streight Lines, and the lesser Circles are Conick Sections.

To draw the 12 a-clock Hour Line.

[2] Having then placed a Piece of a Looking-Glass, about the bigness of a Sixpence, marked thus ☉ in the Figure. Over this Glass hang a Plumb Line at 12 a-Clock, this String will cast a true *Meridian Line* (i.e. it is the true 12 a-clock Hour Line) upon the Floor.

Of the 12 a-clock Hour Line.

† A Cone doth somewhat resemble a Sugar Loaf, and being cut any where *slope-wise* is called a *Conic Section*.

CHAP. Or if you think that way too difficult, you  
 XVI. may find a 12 *a-clock Line* as I have taught  
 in Chap. IV. page 22. This being done, this  
 12 *a-Clock Line on the Floor*, is to be *trans-*  
*ferred* to the *Cieling*, which may be per-  
 formed by the help of *two Plumb Lines*, one  
 held over the *Glass* ☉, and the other held  
 over the other end of the 12 *a-Clock Line* at  
 A, at the other end of the Room; by this  
 means you will have *two points* on the  
*Cieling*, just over your 12 *a-Clock Line* on  
 the *Floor*, to which *two Points* on the *Ciel-*  
*ing* stretch a *Line* blacked with *Lamb*  
*Black and Oil*, and holding it fast at both  
 Ends, (as two *Sawyers*, or *Carpenters* gene-  
 rally do a CHALKED LINE) strike the  
 black 12 *a-Clock Line* on the *Cieling*, repre-  
 sented by A C.

*To draw the Equinoctial.*

[3] Make the *Angle* B ☉ P, equal to the  
*Complement of the Latitude of the Place*, as  
 suppose at *Ormskirk* 36 Deg. 30 Min. which  
 you must do by a *String*, held one end to  
 the *Glass* ☉, and the other to the *Cieling* re-  
 presented by B ☉, and applying the *Edge* of  
 your *Quadrant*, till you find the *String* and  
*Plummet*, cut the *Limb* at 36 Deg. 30 Min.  
 thro' that *Point* of the 12 *a-Clock Line*; at  
 B the *Equinoctial Circle* must pass, which  
 draw at *Right Angles* to the 12 *a-Clock*  
*Line*

Of the  
 Equinoctial  
 Circle.



## Of the Reflective Dial.

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Line A D, and it is a *streight Line* as you see in the *Figure*.

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XVI.

To draw the Tropick of Cancer.

[4] Then, because the Sun's greatest height at 12 at Noon, at Ormskirk is 59 Deg. 59 Min. make the Angle D  $\odot$  P equal thereto by help of your Quadrant and String as before: so is the Point D, the Point in the 12 a-clock Line, where the Tropick of Cancer must pass, which, because it is a lesser Circle of the Sphere, it is not a *streight Line* but a Curve, which must be drawn by help of Table VI; (that is, by having the Sun's height at every Hour the 10th of June for the Latitude of your Place;) so with an even hand, you may draw the Tropick of Cancer G D H.

To draw the Tropick of Capricorn.

[5] Because the Sun's least height at 12 at Noon at Ormskirk is 13 Deg. 1 Min. make the Angle A  $\odot$  P equal thereto, by help of your Quadrant and String, so shall A be the Point in the 12 a-clock Hour Line on the Cieling, where the Tropick of Capricorn must pass, and must be drawn by the Table of the Sun's Altitude at every Hour upon the 10th of December as above directed, so that  $\odot$  D represents the reflected Ray on the longest Day;  $\odot$  B, when

CHAP. he is in the *Equinoctial*, that is, *twice a Year*,  
 XVI. viz. on *March 10th*, and *September 12th*,  
 and ☉ A represents the *reflected Ray* on the  
*shortest Day*.

To draw the Hour Lines.

Of the  
 Hour  
 Lines how  
 drawn.

[6] With any convenient opening of your Compasses, draw the *Semicircle* ☉ L M, and divide it into 12 equal Parts, because 15 Deg. in the *Equinoctial* is equal to one Hour in Time, as by Table III.

Hence, because the Center of the Dial doth not fall in the room, but out of it in the open Air at O, for which reason (before the Hour Lines can be drawn) you must find the Angle that each Hour Line makes with the 12 a-clock Hour Line, their Complements are what they make with the *Equinoctial*; this is easily done by Calculation, but because I have throughout this Treatise laid that Method aside, and kept strictly to a *Mechanick Method*, your best Way will now be to draw an *Horizontal Dial* for the Latitude of Ormskirk, which is 53 Deg. 30 Min. as has been taught in Chap. IV. and with your Compasses and Line of Chords measure the Angles that the Hour Lines make with the Meridian, and set them down in a Table, as followeth.

Then



## Of the Reflective Dial.

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XVI.

Then with your *Quadrant* lay it to the 12 a-clock Hour Line, and make *Angles* there upon the *Cieling* equal to those in the *second Column*, or else you may lay it to the *Equinoctial Line*

| Hours. |    | Angles<br>with the<br>Meridian. |    | Angles<br>with the<br>Equinoct. |    |
|--------|----|---------------------------------|----|---------------------------------|----|
|        | 12 | 0                               | 0  | 0                               | 0  |
| 1      | 11 | 12                              | 10 | 77                              | 50 |
| 2      | 10 | 24                              | 54 | 55                              | 6  |
| 3      | 9  | 38                              | 47 | 51                              | 13 |
| 4      | 8  | 54                              | 19 | 35                              | 41 |
| 5      | 7  | 71                              | 34 | 18                              | 26 |
| 6      |    | 90                              | 00 | 0                               | 00 |

on the *Cieling*, and make the *Angles* of every Hour equal to those in the *third Column* of this *Table*, and by help of your *blackd String*, as before directed, draw the *Hour Lines* upon the *Cieling*, which shall be the *true Hour Lines* required.

### Another Way to draw the Hour Lines.

Or if you think this way too tedious, when you have your *Horizontal Dial* fitted to your *Latitude*, place the *Center* of your *Horizontal Dial* in the *Center* of the *Glass*, and fix a *Thread* in the *Center* of the *Dial*; lay the *Thread* streight over every Hour of your *Horizontal Dial*, fasten it at the other side of the *Room*; and so transfer them to the *Cieling*, as was shewn in drawing the 12 a-clock Line from the *Floor* by help of the *Plumb Lines*; thus have I given you two *Methods* by which you may draw the *Hour Lines* on the *Cieling*, which I leave to the

CHAP. judicious Practitioner to make use of which  
XVI. he pleases.

*How to make a Table for drawing of the  
Hour Lines.*

The framing of a *Table* of the *Angles* that the *Hour Lines* make with the 12 *a-clock Hour Line* and *Equinoctial*, is made after this manner, *viz.* Suppose I would measure the Angle  $D \odot P$  in Plate 9. Fig. 2. Take your *Compasses* and extend on the *Line of Chords* from the end of the *Line* at  $O$  to 60 *Deg.* with that extent set one foot in  $\odot$ , and draw the *Arch*  $P D$ ; take the said *Arch*  $P D$  in your *Compasses*, and apply it to your *Line of Chords*, and you will find it to contain 59 *Deg.* 59 *Min.* and such is the *Angle*  $D \odot P$ . And after the same manner is any other *Angle* measured.



CHAP.



## C H A P. XVII.

*To make a REFRACTED \* Dial.*

**F**OR this purpose you must have in readiness an *Horizontal Dial* for the *Latitude of your Place*, and then stick up a *Pin*, or *Wire*, or assign any Point in any hollow *Bowl*, or *Dish*, to shew the *Hour*, and make that the *Center of your Horizontal Dial*; then fix upon any Place on the *Edges of the Bowl*, or *Dish*, for the *12 a-clock Hour Line*, and transfer the rest of the *Hour Lines* from the *Horizontal Dial* to the *Edge of the Bowl*; and taking away the *Horizontal Dial*, hold up a *String* from the *End of the said Pin* fastned thereto, over the *12 a-clock Hour Line* equal to the *Latitude of your Habitation*; and this is done by applying the *Edge of your Quadrant* to the *String*, till it cuts the *Latitude of the Place* upon the *Limb* thereof.

Then with a *Candle*, by bringing the *Thread* to cast a *Shadow* on any *Hour Point*, just before marked upon the *Edge of the Bowl*, that *Shade* in the *Bowl* is the Place to which the *true Hour Line* must be drawn; and if the *Bowl* be full of *Water*, or any other Li-

\* *Refracted Dials* are such as shew the *true Hour* only by means of some *refracting transparent Fluid*, such as *Water*, &c.

CHAP. *quor*, when the *Hour Lines* are drawn, it  
 XVII. will never shew the *true Hour* by the Sha-  
 dow of the Top of the Pin, but when the  
 Bowl is filled again with the same Liquor †.

† For more particular Satisfaction, see my *Astronomy* under  
 the Word *Refraction*, Vol. I. Page 38.

## C H A P. XVIII.

### *To make a GLOBE Dial.*

*Plate 10. Fig. 1.*

**T**HIS Dial is drawn upon a *solid Ball*  
 or *Globe*, and shews the *Hour* of the  
 Day without a *Style* or *Gnomon*.

*How to  
 form the  
 Plane of a  
 Globe  
 Dial.*

The manner of *turning* round Balls, is  
 well known to Workmen; but if a large  
*Stone Ball* is to be made, that cannot be  
 turned because of its *Weight*.

You must therefore in the first Place form  
 it *globular* with a *Chissel*, and then take a  
 wooden or brass *Semicircle* (as in *Fig. 2.*) of  
 the same Diameter, as you design your *Ball*  
 (the bigger the better;) this being done, turn  
 the *Semicircle* about the *Ball*, and take away  
 all the *Superfluities* with a *Rasp*, until the  
*Semicircle* every where, and every way, just  
 touches the *Superficies* thereof; afterwards  
 make



to Fold out facing page 75

Plate 10

Fig. I.

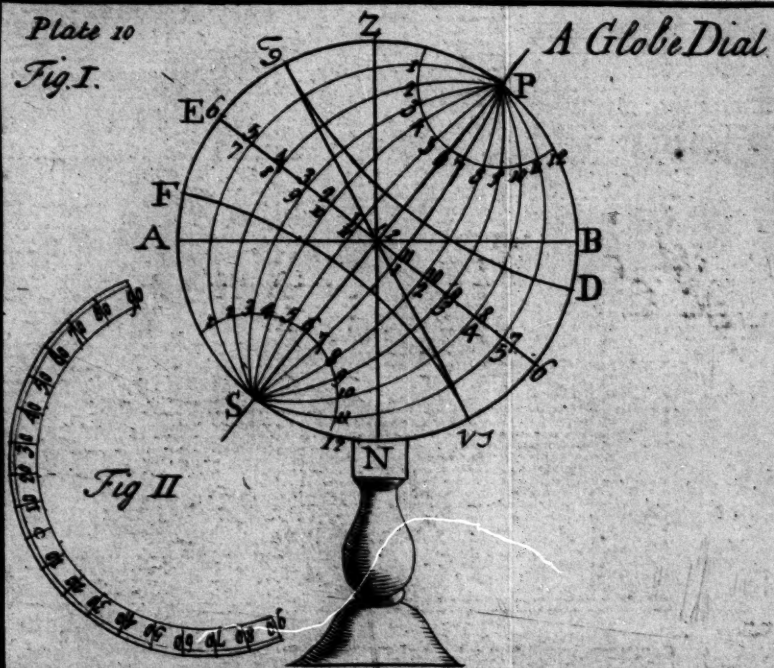
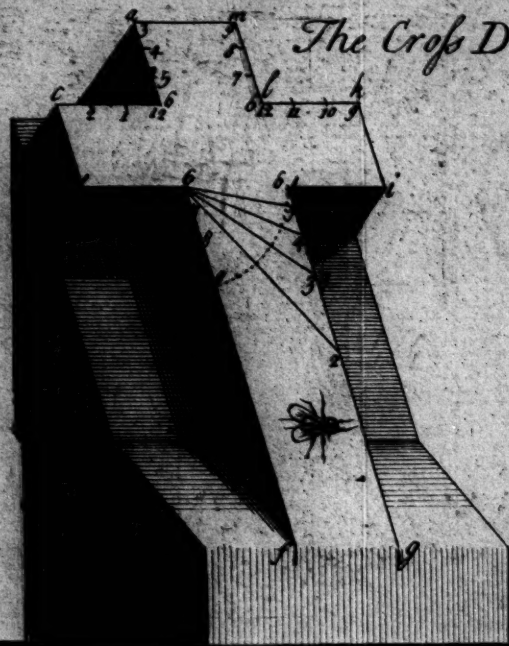


Fig III

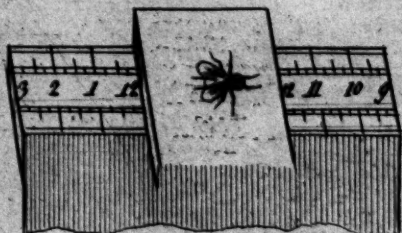
*The Crook Dial*



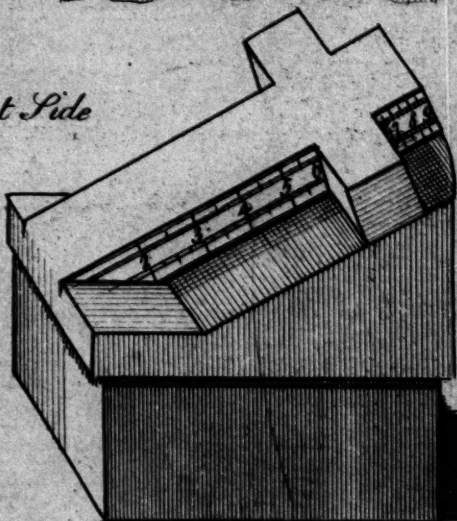
*The Crofs Dial view'd in three different positions*

*South End*

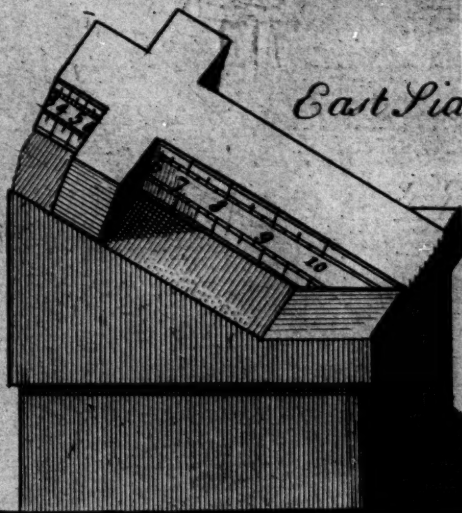
*Plate X*



*West Side*



*East Side*



*to Fold out facing page 75*



## Of the Globe Dial.

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make it smooth with a *Pumice Stone*, or *CHAP.*  
(Sea Dog's) *Fish Skin*. *XVIII.*

### For the Circles of the Sphere.

The Globe being thus finished, and set in your Garden upon a *Pedestal*, as *Figure 1*, proceed to draw thereon the *Circles of the Sphere* (by help of a Pair of *Spheric Compasses*, or a *Semicircle* that just fits the *Globe*) as *A B*, the *Horizon*, *Z N* the *prime Vertical*, so shall *Z* be your *Zenith*, and *N* your *Nadir*. Draw *P S* for the *Earth's Axis* to any *Latitude*, as suppose that of *Dublin 53 Deg. 20 Min.* so shall *P* be the *North Pole*, and *S* the *South Pole* of the *World*. Make *Z Æ* equal to *B P*, and draw *Æ æ* for the *Equinoctial*, which divide into 24 equal Parts, and draw the *Hour Circles* or *Meridians* all meeting in the *Poles* of the *World*.

How to draw the Circles of the Sphere upon the Globe Dial.

An Example of a Globe Dial for Dublin.

Your *Semicircle* being divided into 180 *Deg.* and numbred as you see in *Fig. 2*. mark 23 *Deg. 29 Min.* from the *Equinoctial* at *Æ* to *♄* and *F*, and draw *♄ D* for the *Tropic of Cancer*; and *F ♄* for the *Tropic of Capricorn*; also from the *Poles* at *P* and *S* mark (by help of your *Semicircle*) 23 *Deg. 29 Min.* and draw the two *Polar Circles*; 12, 12. Lastly, Draw *♄ ♄* for the *Ecliptic*, and thereon place the 12 *Signs of the Zodiac*, beginning at the *Equinoctial*, where the *Ecliptic* cuts it with *♈*; at 30 *Degrees*



CHAP. Degrees further, place  $\gamma$ , at 30 Degrees XVIII. from that, put  $\pi$ , at 30 Degrees more, put  $\delta$ , which will be where the *Ecliptic* cuts the *Tropic of Cancer*, and so on, at every 30 Degrees in the *Ecliptic*, place the *Signs* in order thus,  $\alpha$ ,  $\pi$   $\approx$   $\eta$   $\tau$   $\nu$   $\approx$   $\kappa$ . I have omitted them in the Figure to avoid Confusion.

*For the placing of the Hours.*

The *Hours* must be numbred in the *Equinoctial*, placing 12 at the *East* and *West* Points of the *Horizon*, and 6 upon the *Meridian*. Then because one half of the *Globe* (nearly) is illuminated when the *Sun* shines, and the other half remains in *Darkness*, and so the *Extremity* of the *Light* shews the *Hour* in two opposite Places.

How the  
Sun shining  
upon this  
Globe  
Dial would  
exactly re-  
semble the  
Sun shining  
upon the  
Earth it-  
self.

If moreover the *different Countries* on the *Earth's Superficies*, as likewise the *principal Cities* were laid down upon the *Globe*, according to their *true Latitudes* and *Longitudes*, you may discover any Moment the *Sun* shines upon the same, by the *illuminated Part* thereof, what Places on the *Earth* are *enlightened*, and what Places are in *Darkness*. The *Extremity of the Shadow* shews likewise what Places the *Sun* is *Rising* or *Setting* at; and what Places have long *Days*; these with many more curious *Problems*

## Of the Globe Dial.

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blems are seen at one View, too many to be enumerated in this Place.

CHAP.  
XVIII.

*This Dial* is the *most natural* of all others, because it resembles *the Earth itself*, and the *exact* manner of *the Sun's shining* thereon.

*Note*, You may draw as many *Parallels of Declination* upon it as you please, by the *Table* of the *Sun's Declination*. See Table I.

*Also* if *two Wires* be put in, *one* at P and *another* at S, and 12 at the *Meridian*, and the *Hours* numbered as you see, *that Wire* at P, will give the *Hour* in the *Summer*, and that at S the *Hour* in the *Winter*.



CHAP.



*Of the Cross Dial.*

## C H A P. XIX.

*To make a CROSS Dial.**Plate 10. Fig. 3.*

**A** *Cross Dial* is that which shews the true Hour of the Day, without a *Style*, by the *Shadow* of one Part of the Dial itself, appearing upon another Part thereof.

Where one  
of these  
Dials may  
be seen.

There is one of this sort of Dials near the South-West Corner of Middle Moorfields, London\*.

*For the making of this Sort of Dial.*

You need have no regard to the *Latitude* of the Place, for that is to be considered in the placing, and not in the making of it.

[1] In order to which, prepare a Piece of Wood or Stone of what Size you please, and shape it in the Form of a Cross, so that *a b*, *b c*, *c d*, *d e*, *e h*, *b i*, *i k*, *k l*, *l m*,

\* The *Inscription* upon this Dial being cut in Iron, and exposed to the Weather, it is so defaced, that it required much Pains and Art to render it legible, and therefore I desire the Reader's Excuse for preserving it. This Dial was placed here as a Boundary of the Parish of St Stephens, Coleman-street, in the memorable Year 1706, and in the fifth Year of the glorious Reign of our most gracious Sovereign Queen Anne, whom GOD long preserve. Robert Trevitt, Painter Fecit.

and

## Of the Cross Dial.

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and  $ma$  may be all equal:  $ef$ , may be CHAP:  
 more than double to  $ae$ : that in London is XIX.  
 25 Inches, and 5 Tenths of an Inch long from   
 $a$  to  $f$ , and  $am$  is 4 Inches and 8 Tenths,  
 $ef$  15 Inches and 8 Tenths, and the Depth  
 or Thickness is 6 Inches, 18 Tenths. This  
 premised

[2] Set one Foot of your Compasses in  $e$ ,  
 and draw the Arch or Quadrant  $bn$ , which  
 divide into six equal Parts, for six Hours,  
 because it is a Quarter of a Circle; lay a  
 Ruler from the Center  $e$ , and draw  $eo$ ,  $ep$ ,  
 $eq$ .

[3] Now the Position of this Dial be- Of the  
Position  
of this  
Dial.  
 ing such that its End  $am$ , must face the  
 South, and the upper Part of it to lie pa-  
 rallel with the Equinoctial, the Sun at 12 a-  
 clock will shine just along the Line  $ab$  and  
 $ml$ . Therefore you must place 12 at  $b$  and  
 $l$ , then it is plain that from 12 to 3 the Sha-  
 dow of the Corner  $a$  will pass along the Line  
 $bc$ ; therefore take from the Quadrant just  
 now drawn  $bn$  the Distance  $bo$ , and set it  
 from 12 to 1.

[4] Take also  $bp$ , and set from 12 to 2,  
 $bq$  being equal to  $bc$ , at  $c$  place 3, where  
 the Shadow of the Corner  $a$  goes quite off the  
 Dial at  $c$ , or 3 in the Afternoon; but then  
 the Shadow of the Corner  $i$ , will come on  
 the Side  $hg$  at  $q$ , or 3 a-clock, where place  
 the Figure 3; at  $p$  4, at  $o$  5, and at  $b$  6 in  
 the very Corner: because at 6 the Sun will  
 shine

CHAP. shine *right along* the Line *i b*; place 6 also  
 XIX. at *the Corner l*, because the Sun at 6 shines  
 } *right along* the Line *l k*, and from 6 till 9,  
 (if it be in a *Latitude* where the Sun continues up so late at Night) the *Shadow* of  
*the Corner* at *k* is passing *along* the Line *l m*.

[5] Therefore take in your *Compasses* the  
*Distance b o*, and set from 6 to 7.

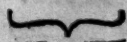
[6] Take *b p*, and set from 6 to 8 along  
 the Line *l m*; and the *Distance b q* is *equal*  
 to *l m*; therefore at *the Corner m*, place 9,  
 because the *Shadow* of *the Corner k*, goes off  
 the Line *l m* at 9.

[7] Then for the *Morning Hours* the *Shadow*  
 of the *Point c* will enter upon the Line  
*a b* at the *Point a*, just at 3 in *the Morning*;  
 therefore draw *Lines* from 7 and 8 in the  
 Line *l m*, which let be drawn *parallel* to *a*  
*m*, and having placed 3 at *the Corner a*,  
 place 4 right against 8, 5 against 7, so will  
 6 be in *the Corner b*, because at 6 the Sun  
 shines just along the Line *c b*, and from 6  
 till 9 the *Shadow* of the *Point d* is passing  
 along the Side *e f*.

[8] Therefore having placed 6 in *the Cor-*  
*ner e*, draw *Lines* from the *Points o p q*,  
 parallel to *d i*, and at *those Points* put the  
 Figures 7, 8, 9, for when *the Shadow* of  
 the *Point d* comes to 9; the *Shadow* of *the*  
*Point m* is at the *Point k*, and from 9 to 12  
 the *Shadow* of *m* passeth along the Line *k l*,  
 and at 12 the *Shadow* of *m*, is come to *l*.

[9] There-



[9] Therefore take the Distances  $bo$ ,  $bp$ ,  $CHAP.$   
 $bq$ , and set them from  $l$ , to  $11$  and  $10$ , the  $XIX.$   
*Distance  $bq$  being just equal to  $lk$ , and thus*   
 is the Dial finished.

The Sun as it goes off from one Part of it comes on to another Part thereof; so that the Time of the Day may always be found upon some Part or other of it, when the Sun shineth.

The Reason why these Dials require *Why these Dials require Thick-*  
*Thickness*, as well as other Dimensions, is, because being placed parallel to the Equinoctial, the Sun shines upon the upper Face *ness.*  
 all the Summer, and on the longest Day is elevated 23 Deg. 29 Min. above the Plane of the Dial, and consequently the Shadow of  $a$  will fall at Noon in the Line  $ab$ , and not in the Point  $b$ , but at an Angle of 23 Deg. 29 Min. therewith, (that being the Sun's greatest Declination on the longest Day.) And on the shortest Day the Shadow of  $a$ , will be below the Plane or Line  $ab$ , and make an Angle of 23 Deg. 29 Min.

This Dial is universal, for when you have made one, according to the above Directions, there is nothing to do but to fix it in your Garden, &c. by help of your Quadrant to the Elevation of the Equinoctial, or Complement of the Latitude of your Habitation, and so that the Side  $ab$  may exactly face the South. *How you must set this Dial truly.*

CHAP. XIX. If you would place this Dial in any Place within the Polar Circles, you must then make all the *Ends* of an *equal* length, viz. *e f*, &c. equal to *a b*; otherwise, the Shadow would quit one Side before it comes on another, as you may the better perceive by viewing the Figure in Plate X. Fig. 3.

*What to be observed if this Dial were to be placed within the Polar Circles.*

Thus having in the foregoing Work shewn how to make all manner of useful Dials, I think it only remains now to shew how

### To make a WINDOW Dial.

This is a very useful Dial, for by it you may know the Hour of the Day tho' the Sun *doth not shine outbright*, but appears ever so little thro' the Clouds: And so you may in the Night by the *Stars*, and *Moon*.

If your Window face any Point of the *Compass*, near the *South* (is best) then find its *Declination*, as has been taught in Chap. X. and upon a good Sheet of Paper draw the draught of your Dial, as has been taught in Chap. XI.

Place the Center of your Paper Dial upon the *Window Frame* just over the *Glass*, in the very Place where you design to fix the *Style*, that the 12 a-clock Hour Line may fall streight down the *Window*; and by help of a *String*, or *Ruler*, mark the Hours from

## Of the Window Dial.

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from your *Paper draught* upon the Win-  
dow. CHAP. XIX.

Then get an *Iron Rod* about the *Thicknes* of your *Hour Lines*, and nail it to the Window Frame *exactly* in *that Place* where the Center of your *Paper draught* was placed, and set it to the *Latitude of your Place* by help of your *Quadrant*, which is done by putting *that Edge* of it to the *Style* wherein the *Sights* are, and raising the *Style* higher or lower till the Thread cut *the Limb* in the *Degree of the Latitude of your Place*; and there fasten it at *right Angles* over the *Sub-style Line*.

You may put Figures (or any Marks for your own Information) to the *Hour Lines*, and thus is your Dial finished.

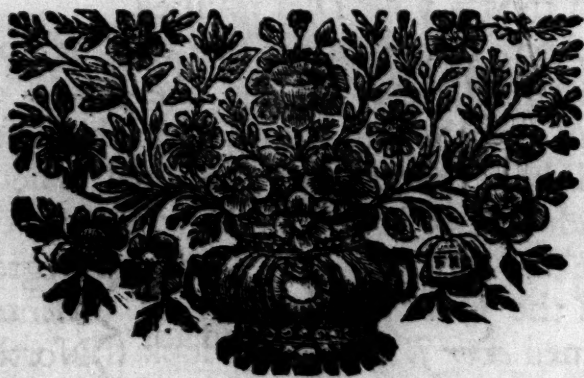
And, how pleasant this will be, to sit in your House, &c. to see the Time of the Day that the Sun shines upon the Window, will best appear from the Dial when thus made: since at any Time when you can see the Sun just *thro' the Clouds*, you may then tell the Hour of the Day as well as if it shined *ever so bright*; for look thro' the Window and take the *Style between your Eye and the Sun*, and at the same Time you'll see the Hour where the *Style's shade* will fall upon the Window, and that is the true Hour of the Day.

*Also*, in the Night you may do the same by any *known Star*, by first knowing the



CHAP. Time the Star will be upon the *Meridian*  
XIX. or *South*, and as much as it wants of the  
~~~~~ *South* by the Dial *subtracted* from the Time  
of *Southing*, gives the *true Hour* of the
Night, but if it be *past* the *South* by the
Dial, add so much to the Time of *South-*
ing, and you have the Time of the *Night*.
The same Method is to be used for the
Time of the *Night* by the *Moon*.

This Method of *transferring* the *Hour*
Lines from your *proper draught*, is what
you may use in making of any Dial,
which I recommend as being most practi-
cable.



TABLE

TABLE I.

A TABLE of the *Sun's Declination* exactly calculated for the Year 1738, which (for the Use of Dialling) will serve for this Age without any sensible Error.

Note $\left. \begin{array}{c} \text{D.} \\ \text{M.} \\ \text{N.} \\ \text{S.} \end{array} \right\}$ stand for $\left. \begin{array}{c} \text{Degrees} \\ \text{Minutes} \\ \text{North} \\ \text{South} \end{array} \right\}$

T A B L E I.

A T A B L E of the *Sun's Declination.*

| | <i>Jan.</i> | | <i>Feb.</i> | | <i>Mar.</i> | | <i>April</i> | | <i>May</i> | | <i>June</i> | |
|----|-------------|------|-------------|------|-------------|------|--------------|------|------------|------|-------------|------|
| | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. |
| 1 | 21 | S 39 | 13 | S 39 | 3 | S 17 | 8 | N 43 | 18 | N 10 | 23 | N 11 |
| 2 | 21 | 29 | 13 | 19 | 2 | 53 | 9 | 4 | 18 | 24 | 23 | 15 |
| 3 | 21 | 18 | 12 | 59 | 2 | 29 | 9 | 26 | 18 | 39 | 23 | 18 |
| 4 | 21 | 8 | 12 | 38 | 2 | 6 | 9 | 48 | 18 | 54 | 23 | 21 |
| 5 | 20 | 56 | 12 | 18 | 1 | 42 | 10 | 4 | 19 | 7 | 23 | 23 |
| 6 | 20 | 44 | 11 | 57 | 1 | 18 | 10 | 30 | 19 | 21 | 23 | 25 |
| 7 | 20 | 32 | 11 | 36 | 0 | 55 | 10 | 51 | 19 | 35 | 23 | 27 |
| 8 | 20 | 20 | 11 | 14 | 0 | 31 | 11 | 12 | 19 | 48 | 23 | 28 |
| 9 | 20 | 7 | 10 | 53 | 0 | 7 | 11 | 33 | 20 | 0 | 23 | 29 |
| 10 | 19 | 54 | 10 | 31 | 0 | N 17 | 11 | 53 | 20 | 13 | 23 | 29 |
| 11 | 19 | 40 | 10 | 9 | 0 | 40 | 12 | 13 | 20 | 25 | 23 | 29 |
| 12 | 19 | 26 | 9 | 47 | 1 | 4 | 12 | 34 | 20 | 36 | 23 | 28 |
| 13 | 19 | 11 | 9 | 25 | 1 | 28 | 12 | 54 | 20 | 48 | 23 | 27 |
| 14 | 18 | 57 | 9 | 3 | 1 | 51 | 13 | 13 | 20 | 59 | 23 | 26 |
| 15 | 18 | 42 | 8 | 40 | 2 | 14 | 13 | 32 | 21 | 9 | 23 | 24 |
| 16 | 18 | 26 | 8 | 18 | 2 | 38 | 13 | 52 | 21 | 19 | 23 | 22 |
| 17 | 18 | 11 | 7 | 55 | 3 | 2 | 14 | 11 | 21 | 29 | 23 | 20 |
| 18 | 17 | 54 | 7 | 33 | 3 | 25 | 14 | 29 | 21 | 39 | 23 | 17 |
| 19 | 17 | 38 | 7 | 10 | 3 | 48 | 14 | 48 | 21 | 48 | 23 | 13 |
| 20 | 17 | 21 | 6 | 47 | 4 | 11 | 15 | 6 | 21 | 57 | 23 | 9 |
| 21 | 17 | 4 | 6 | 23 | 4 | 35 | 15 | 24 | 22 | 5 | 23 | 5 |
| 22 | 16 | 47 | 6 | 1 | 4 | 58 | 15 | 42 | 22 | 13 | 23 | 1 |
| 23 | 16 | 29 | 5 | 37 | 5 | 21 | 15 | 59 | 22 | 21 | 22 | 56 |
| 24 | 16 | 12 | 5 | 14 | 5 | 44 | 16 | 17 | 22 | 28 | 22 | 50 |
| 25 | 15 | 53 | 4 | 51 | 6 | 6 | 16 | 34 | 22 | 35 | 22 | 44 |
| 26 | 15 | 35 | 4 | 27 | 6 | 29 | 16 | 50 | 22 | 41 | 22 | 38 |
| 27 | 15 | 16 | 4 | 4 | 6 | 52 | 17 | 7 | 22 | 47 | 22 | 32 |
| 28 | 14 | 57 | 3 | 40 | 7 | 14 | 17 | 23 | 22 | 53 | 22 | 25 |
| 29 | 14 | 38 | | | 7 | 37 | 17 | 39 | 22 | 58 | 22 | 17 |
| 30 | 14 | 19 | | | 7 | 59 | 17 | 54 | 23 | 3 | 22 | 10 |
| 31 | 13 | 59 | | | 8 | 21 | | | 23 | 7 | | |

TABLE I.

A TABLE of the *Sun's Declination.*

| | <i>July</i> | | <i>Aug.</i> | | <i>Sept.</i> | | <i>Octob.</i> | | <i>Novem.</i> | | <i>Decemb.</i> | |
|----|-------------|-----|-------------|-----|--------------|------|---------------|------|---------------|------|----------------|-----|
| | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. |
| 1 | 22 | N 1 | 15 | N 1 | 4 | N 12 | 7 | S 26 | 17 | S 46 | 23 | S 8 |
| 2 | 21 | 53 | 14 | 43 | 3 | 49 | 7 | 48 | 18 | 3 | 23 | 12 |
| 3 | 21 | 44 | 14 | 25 | 3 | 25 | 8 | 11 | 18 | 18 | 23 | 16 |
| 4 | 21 | 35 | 14 | 6 | 3 | 2 | 8 | 33 | 18 | 33 | 23 | 19 |
| 5 | 21 | 25 | 13 | 47 | 2 | 39 | 8 | 56 | 18 | 48 | 23 | 22 |
| 6 | 21 | 15 | 13 | 28 | 2 | 16 | 9 | 17 | 19 | 3 | 23 | 24 |
| 7 | 21 | 4 | 13 | 9 | 1 | 53 | 9 | 40 | 19 | 18 | 23 | 26 |
| 8 | 20 | 54 | 12 | 49 | 1 | 29 | 10 | 1 | 19 | 32 | 23 | 28 |
| 9 | 20 | 43 | 12 | 29 | 1 | 6 | 10 | 23 | 19 | 45 | 23 | 29 |
| 10 | 20 | 32 | 12 | 10 | 0 | 42 | 10 | 45 | 19 | 59 | 23 | 29 |
| 11 | 20 | 20 | 11 | 50 | 0 | 19 | 11 | 6 | 20 | 12 | 23 | 29 |
| 12 | 20 | 8 | 11 | 29 | 0 | S 4 | 11 | 27 | 20 | 25 | 23 | 28 |
| 13 | 19 | 55 | 11 | 9 | 0 | 28 | 11 | 48 | 20 | 37 | 23 | 27 |
| 14 | 19 | 43 | 10 | 48 | 0 | 51 | 12 | 9 | 20 | 49 | 23 | 26 |
| 15 | 19 | 30 | 10 | 27 | 1 | 15 | 12 | 30 | 21 | 1 | 23 | 24 |
| 16 | 19 | 16 | 10 | 6 | 1 | 38 | 12 | 50 | 21 | 12 | 23 | 22 |
| 17 | 19 | 3 | 9 | 45 | 2 | 2 | 13 | 10 | 21 | 22 | 23 | 19 |
| 18 | 18 | 48 | 9 | 24 | 2 | 25 | 13 | 30 | 21 | 33 | 23 | 16 |
| 19 | 18 | 34 | 9 | 2 | 2 | 49 | 13 | 50 | 21 | 43 | 23 | 12 |
| 20 | 18 | 19 | 8 | 40 | 3 | 12 | 14 | 10 | 21 | 52 | 23 | 8 |
| 21 | 18 | 4 | 8 | 19 | 3 | 36 | 14 | 29 | 22 | 1 | 23 | 3 |
| 22 | 17 | 49 | 7 | 57 | 3 | 59 | 14 | 49 | 22 | 10 | 22 | 58 |
| 23 | 17 | 34 | 7 | 35 | 4 | 22 | 15 | 7 | 22 | 18 | 22 | 52 |
| 24 | 17 | 18 | 7 | 12 | 4 | 45 | 15 | 26 | 22 | 26 | 22 | 46 |
| 25 | 17 | 2 | 6 | 50 | 5 | 9 | 15 | 45 | 22 | 33 | 22 | 39 |
| 26 | 16 | 45 | 6 | 28 | 5 | 32 | 16 | 2 | 22 | 40 | 22 | 32 |
| 27 | 16 | 29 | 6 | 5 | 5 | 54 | 16 | 20 | 22 | 47 | 22 | 25 |
| 28 | 16 | 12 | 5 | 43 | 6 | 18 | 16 | 38 | 22 | 53 | 22 | 17 |
| 29 | 15 | 55 | 5 | 20 | 6 | 40 | 16 | 55 | 22 | 58 | 22 | 9 |
| 30 | 15 | 37 | 4 | 57 | 7 | 3 | 17 | 13 | 23 | 3 | 22 | 0 |
| 31 | 15 | 19 | 4 | 35 | | | 17 | 29 | | | 21 | 51 |

T H E
Explanation and Use
Of the foregoing
T A B L E.

THIS Table shew you the *Sun's Declination* * every Day at Noon, and is exactly calculated to the Year 1738 to the Meridian of London, which will serve for this Age near enough for any Purpose in *Dialling*.

The Letter N stands for *North Declination*, and S for *South*.

It is of good use to find the *Latitude of the Place* of your Habitation: this may be done by taking the height of the Sun at Noon with your *Quadrant*: and if the *Sun's Declination* be *South*, ADD it to the *Altitude* or height at Noon, but if it be *North* SUBTRACT: the Sum or Difference is the height of the *Equinoctial* or *Complement of the Latitude* in the *Northern Hemisphere*, but in the *Southern* use the contrary Titles.

I

Example.

* The *Declination of the Sun* is his Distance from the *Equinoctial*, and in all Things of this kind the Sun is supposed to move parallel to the *Equinoctial* all that Day, and tho' it does not so in fact, yet it serves in *Dialling* near enough the Truth: and this *Declination* never exceeds 23 Deg. 29 Min. as appears by the Table.

Example.

Admit you are at a certain Place in the *North* of *England*, &c. and upon the 14th of *February* you observe the *Sun's height* at *Noon* with your *Quadrant* to be 26 *Deg.* 30 *Min.* what is the *Latitude of Observation*?

| <i>Operation.</i> | <i>Deg.</i> | <i>Min.</i> |
|--|-------------|-------------|
| To the <i>Sun's Altitude</i> observed | — | 26 30 |
| Add the <i>Sun's Declination S.</i> | — | 9 3 |
| Sum is the <i>height of Equinoctial</i> | — | 35 33 |
| <i>Subtract</i> it from a <i>Quadrant</i> or | — | 90 00 |
| The <i>Latitude of the Place North</i> is | — | 54 27 |

Example 2.

| | <i>Deg.</i> | <i>Min.</i> |
|--|-------------|-------------|
| From the <i>Sun's Altitude</i> observed | — | 44 51 |
| <i>Subtract</i> the <i>Sun's Declination North</i> | | 10 51 |
| Remains the <i>Complement of the Latitude</i> | | 34 00 |
| <i>Subtract</i> from a <i>Quadrant</i> or | — | 90 00 |
| Remains the <i>Latitude North</i> | — | 56 00 |

TABLE II.

A TABLE of the *Equation of Time* for the Regulating of Clocks and Watches by a Sun-Dial.

TABLE II.

A TABLE for *Regulating* Pendulum Clocks, &c. with the Sun Dials.

| | <i>Jan.</i> | | <i>Feb.</i> | | <i>Mar.</i> | | <i>April</i> | | <i>May</i> | | <i>June</i> | |
|----|-------------|----|-------------|----|-------------|----|--------------|----|------------|----|-------------|----|
| | M. | S. | M. | S. | M. | S. | M. | S. | M. | S. | M. | S. |
| 1 | 8 | 58 | 14 | 48 | 10 | 8 | 0 | 50 | 4 | 2 | 0 | 50 |
| 2 | 9 | 21 | 14 | 47 | 9 | 51 | 0 | 34 | 4 | 4 | 0 | 37 |
| 3 | 9 | 43 | 14 | 45 | 9 | 34 | 0 | 18 | 4 | 5 | 0 | 25 |
| 4 | 10 | 5 | 14 | 42 | 9 | 17 | 0 | 2 | 4 | 5 | 0 | 13 |
| 5 | 10 | 26 | 14 | 38 | 9 | 0 | 0 | 3 | 4 | 4 | 0 | 1 |
| 6 | 10 | 45 | 14 | 33 | 8 | 42 | 0 | 28 | 4 | 3 | 0 | 11 |
| 7 | 11 | 4 | 14 | 28 | 8 | 24 | 0 | 42 | 4 | 2 | 0 | 24 |
| 8 | 11 | 22 | 14 | 22 | 8 | 5 | 0 | 56 | 4 | 0 | 0 | 37 |
| 9 | 11 | 40 | 14 | 16 | 7 | 47 | 1 | 10 | 3 | 58 | 0 | 50 |
| 10 | 11 | 57 | 14 | 9 | 7 | 29 | 1 | 23 | 3 | 56 | 1 | 3 |
| 11 | 12 | 14 | 14 | 1 | 7 | 11 | 1 | 36 | 3 | 53 | 1 | 16 |
| 12 | 12 | 30 | 13 | 52 | 6 | 52 | 1 | 48 | 3 | 49 | 1 | 29 |
| 13 | 12 | 44 | 13 | 43 | 6 | 33 | 2 | 0 | 3 | 44 | 1 | 42 |
| 14 | 12 | 58 | 13 | 34 | 6 | 15 | 2 | 11 | 3 | 38 | 1 | 55 |
| 15 | 13 | 11 | 13 | 24 | 5 | 56 | 2 | 21 | 3 | 32 | 2 | 7 |
| 16 | 13 | 23 | 13 | 13 | 5 | 37 | 2 | 31 | 3 | 25 | 2 | 20 |
| 17 | 13 | 35 | 13 | 2 | 5 | 19 | 2 | 41 | 3 | 18 | 2 | 32 |
| 18 | 13 | 46 | 12 | 50 | 5 | 1 | 2 | 51 | 3 | 11 | 2 | 44 |
| 19 | 13 | 56 | 12 | 37 | 4 | 42 | 3 | 0 | 3 | 4 | 2 | 56 |
| 20 | 14 | 5 | 12 | 28 | 4 | 23 | 3 | 8 | 2 | 56 | 3 | 8 |
| 21 | 14 | 13 | 12 | 12 | 4 | 4 | 3 | 15 | 2 | 47 | 3 | 19 |
| 22 | 14 | 20 | 11 | 58 | 3 | 45 | 3 | 22 | 2 | 38 | 3 | 30 |
| 23 | 14 | 26 | 11 | 43 | 3 | 27 | 3 | 29 | 2 | 29 | 3 | 41 |
| 24 | 14 | 32 | 11 | 28 | 3 | 9 | 3 | 35 | 2 | 19 | 3 | 52 |
| 25 | 14 | 37 | 11 | 13 | 2 | 51 | 3 | 41 | 2 | 9 | 4 | 2 |
| 26 | 14 | 41 | 10 | 58 | 2 | 33 | 3 | 46 | 1 | 59 | 4 | 12 |
| 27 | 14 | 44 | 10 | 42 | 2 | 15 | 3 | 50 | 1 | 48 | 4 | 22 |
| 28 | 14 | 46 | 10 | 25 | 1 | 57 | 3 | 54 | 1 | 37 | 4 | 31 |
| 29 | 14 | 47 | | | 1 | 40 | 3 | 57 | 1 | 26 | 4 | 40 |
| 30 | 14 | 48 | | | 1 | 23 | 4 | 0 | 1 | 14 | 4 | 48 |
| 31 | 14 | 49 | | | 1 | 6 | | | 1 | 3 | | |

TABLE II.

A TABLE for Regulating Pendulum Clocks, &c. with the Sun Dials.

| | July | | Aug. | | Sept. | | Octob. | | Novem. | | Decemb. | |
|----|------|----|------|----|-------|----|--------|----|--------|----|---------|----|
| | M. | S. | M. | S. | M. | S. | M. | S. | M. | S. | M. | S. |
| 1 | 4 | 57 | 4 | 34 | 3 | 55 | 13 | 28 | 15 | 34 | 5 | 47 |
| 2 | 5 | 5 | 4 | 24 | 4 | 16 | 13 | 41 | 15 | 26 | 5 | 18 |
| 3 | 5 | 12 | 4 | 14 | 4 | 37 | 13 | 54 | 15 | 16 | 4 | 49 |
| 4 | 5 | 19 | 4 | 3 | 4 | 58 | 14 | 9 | 15 | 5 | 4 | 20 |
| 5 | 5 | 25 | 3 | 52 | 5 | 19 | 14 | 21 | 14 | 54 | 3 | 50 |
| 6 | 5 | 31 | 3 | 40 | 5 | 40 | 14 | 33 | 14 | 42 | 3 | 21 |
| 7 | 5 | 36 | 3 | 27 | 6 | 1 | 14 | 44 | 14 | 30 | 2 | 51 |
| 8 | 5 | 41 | 3 | 13 | 6 | 22 | 14 | 54 | 14 | 16 | 2 | 21 |
| 9 | 5 | 45 | 2 | 59 | 6 | 43 | 15 | 4 | 14 | 1 | 1 | 51 |
| 10 | 5 | 48 | 2 | 45 | 7 | 4 | 15 | 14 | 13 | 46 | 1 | 21 |
| 11 | 5 | 50 | 2 | 31 | 7 | 25 | 15 | 23 | 13 | 30 | 0 | 51 |
| 12 | 5 | 52 | 2 | 16 | 7 | 45 | 15 | 32 | 13 | 13 | 0 | 21 |
| 13 | 5 | 54 | 2 | 1 | 8 | 5 | 15 | 40 | 12 | 55 | 0 | 9 |
| 14 | 5 | 56 | 1 | 45 | 8 | 25 | 15 | 46 | 12 | 37 | 0 | 39 |
| 15 | 5 | 57 | 1 | 29 | 8 | 45 | 15 | 52 | 12 | 18 | 1 | 9 |
| 16 | 5 | 57 | 1 | 12 | 9 | 5 | 15 | 57 | 11 | 59 | 1 | 39 |
| 17 | 5 | 55 | 0 | 55 | 9 | 25 | 16 | 1 | 11 | 39 | 2 | 9 |
| 18 | 5 | 53 | 0 | 38 | 9 | 45 | 16 | 5 | 11 | 18 | 2 | 38 |
| 19 | 5 | 51 | 0 | 20 | 10 | 5 | 16 | 8 | 10 | 56 | 3 | 7 |
| 20 | 5 | 49 | 0 | 2 | 10 | 24 | 16 | 10 | 10 | 33 | 3 | 36 |
| 21 | 5 | 46 | 0 | 16 | 10 | 43 | 16 | 12 | 10 | 10 | 4 | 5 |
| 22 | 5 | 43 | 0 | 34 | 11 | 2 | 16 | 14 | 9 | 46 | 4 | 34 |
| 23 | 5 | 39 | 0 | 53 | 11 | 20 | 16 | 13 | 9 | 21 | 5 | 2 |
| 24 | 5 | 34 | 1 | 13 | 11 | 38 | 16 | 12 | 8 | 56 | 5 | 29 |
| 25 | 5 | 29 | 1 | 33 | 11 | 55 | 16 | 10 | 8 | 30 | 5 | 56 |
| 26 | 5 | 22 | 1 | 53 | 12 | 12 | 16 | 7 | 8 | 4 | 6 | 23 |
| 27 | 5 | 15 | 2 | 13 | 12 | 28 | 16 | 3 | 7 | 38 | 6 | 50 |
| 28 | 5 | 8 | 2 | 33 | 12 | 44 | 15 | 59 | 7 | 11 | 7 | 16 |
| 29 | 5 | 1 | 2 | 54 | 12 | 59 | 15 | 54 | 6 | 46 | 7 | 41 |
| 30 | 4 | 53 | 3 | 15 | 13 | 14 | 15 | 48 | 6 | 16 | 8 | 5 |
| 31 | 4 | 44 | 3 | 35 | — | — | 15 | 41 | — | — | 8 | 29 |

T H E
Explanation and Use
Of the foregoing

T A B L E.

THIS is a Table of *Equation of Time*, that is, it shews you what the Sun *gains* or *loses* of the Pendulum Clock *every Day*; for the *Pendulum Clock* keeps *equal Time* all the Year round, tho' the Sun doth not do so, but is *very unequal* in its Motion, *sometimes too fast*, and at other Times *too slow*, as the Table plainly shews; so that if at any Time you want to set your *Clock* or *Watch* by your *Sun-Dial*, you must look into this Table, and observe what the *Equation* is on that Day, and set it accordingly, so many *Minutes* and *Seconds*, more or less, as you see the Clock is *too fast* or *slow* for the Sun.

For Instance, January 3d at Noon, I see the Clock is 9 Min. 43 Seconds too fast for the Sun, &c.

Note, In this Table this Mark $+$ signifies Addition and $-$ Subtraction.

TABLE

TABLE III.

A TABLE for converting
Hours and *Minutes* of *Time*
into *Degrees* and *Minutes*
of the *Equinoctial*, and for
the turning of *Degrees* and
Minutes of the *Equinoctial*
into *Hours* and *Minutes* of
Time.

TABLE III.

A TABLE for turning *Hours* and *Minutes* into *Degrees* of the Equinoctial and *è contra*.

| H | ° | ' | ° | ' | ° | ' | ° | ' | ° | ' |
|----|-----|-----|----|-----|-----|----|-----|-----|----|-----|
| 1 | 1 | 11 | 1 | 11 | 11 | 1 | 11 | 11 | 1 | 11 |
| 11 | 11 | 111 | 11 | 111 | 111 | 11 | 111 | 111 | 11 | 111 |
| 1 | 15 | 1 | 0 | 15 | 21 | 5 | 15 | 41 | 10 | 15 |
| 2 | 30 | 2 | 0 | 30 | 22 | 5 | 30 | 42 | 10 | 30 |
| 3 | 45 | 3 | 0 | 45 | 23 | 5 | 45 | 43 | 10 | 45 |
| 4 | 60 | 4 | 1 | 0 | 24 | 6 | 0 | 44 | 11 | 0 |
| 5 | 75 | 5 | 1 | 15 | 25 | 6 | 15 | 45 | 11 | 15 |
| 6 | 90 | 6 | 1 | 30 | 26 | 6 | 30 | 46 | 11 | 30 |
| 7 | 105 | 7 | 1 | 45 | 27 | 6 | 45 | 47 | 11 | 45 |
| 8 | 120 | 8 | 2 | 0 | 28 | 7 | 0 | 48 | 12 | 0 |
| 9 | 135 | 9 | 2 | 15 | 29 | 7 | 15 | 49 | 12 | 15 |
| 10 | 150 | 10 | 2 | 30 | 30 | 7 | 30 | 50 | 12 | 30 |
| 11 | 165 | 11 | 2 | 45 | 31 | 7 | 45 | 51 | 12 | 45 |
| 12 | 180 | 12 | 3 | 0 | 32 | 8 | 0 | 52 | 13 | 0 |
| 13 | 195 | 13 | 3 | 15 | 33 | 8 | 15 | 53 | 13 | 15 |
| 14 | 210 | 14 | 3 | 30 | 34 | 8 | 30 | 54 | 13 | 30 |
| 15 | 225 | 15 | 3 | 45 | 35 | 8 | 45 | 55 | 13 | 45 |
| 16 | 240 | 16 | 4 | 0 | 36 | 9 | 0 | 56 | 14 | 0 |
| 17 | 255 | 17 | 4 | 15 | 37 | 9 | 15 | 57 | 14 | 15 |
| 18 | 270 | 18 | 4 | 30 | 38 | 9 | 30 | 58 | 14 | 30 |
| 19 | 285 | 19 | 4 | 45 | 39 | 9 | 45 | 59 | 14 | 45 |
| 20 | 300 | 20 | 5 | 0 | 40 | 10 | 0 | 60 | 15 | 0 |
| 21 | 315 | | | | | | | | | |
| 22 | 330 | | | | | | | | | |
| 23 | 345 | | | | | | | | | |
| 24 | 360 | | | | | | | | | |

Note

H

°

'

"

'''

stand for

Hours

Degrees

Minutes

Seconds

Thirds

THE Explanation and Use

Of the foregoing

T A B L E.

THIS Table shews how to convert *Time into Motion*, and *Motion into Time*; as suppose I had 5 *Hours* 13 *Min.* 29 *Seconds* to be turned into *Degrees* and *Minutes* of the *Equinoctial*, i. e. into *Motion*; the *Operation* stands thus.

| | ° | ' | " | |
|---------------------|-------|----|----|-------|
| 5 <i>Hours</i> = | 75 | 0 | 00 | } add |
| 13 <i>Minutes</i> = | 3 | 15 | 00 | |
| 29 <i>Seconds</i> = | 0 | 7 | 15 | |
| | <hr/> | | | |

The *Sum* — 78 22 15 for answer.

Again,

Again, suppose I would turn 78 Deg.
22 Min. 15 Seconds into Time, then the
Work will stand thus.

| | | <i>b</i> | <i>l</i> | <i>ll</i> | |
|---------|------|----------|----------|-----------|-------|
| Degrees | 75 = | 5 | 0 | 0 | } add |
| Degrees | 3 = | 0 | 12 | 0 | |
| Minutes | 15 = | 0 | 1 | 0 | |
| Minutes | 7 = | 0 | 1 | 28 | |
| Seconds | 15 = | 0 | 0 | 1 | |

The Sum — 5 13 29 for answer.



TABLE

TABLE IV.

A TABLE of *Meridional Angles*, shewing the *Degrees* of each *Hour Line* from 12 a-Clock, upon all *Horizontal* and *North* and *South Erect* *Direct* *Reclining* and *Inclining* *Dials*, from the *Equinoctial* to the *Poles*.

H

TABLE

TABLE IV.

A TABLE of Meridional Angles.

| For. Dial Lat. | XI I | | X II | | IX III | | VIII IV | | VII V | | VI | | South Dial Lat. |
|----------------|------|----|------|----|--------|----|---------|----|-------|----|----|----|-----------------|
| | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | |
| 0 | 0 | 00 | 0 | 00 | 0 | 00 | 0 | 0 | 0 | 0 | 0 | 0 | 90 |
| 1 | 0 | 16 | 0 | 34 | 1 | 00 | 1 | 44 | 3 | 44 | 90 | 0 | 89 |
| 2 | 0 | 32 | 1 | 9 | 2 | 00 | 3 | 27 | 7 | 25 | 90 | 0 | 88 |
| 3 | 0 | 48 | 1 | 44 | 3 | 00 | 5 | 11 | 11 | 3 | 90 | 0 | 87 |
| 4 | 1 | 5 | 2 | 19 | 4 | 00 | 6 | 54 | 14 | 36 | 90 | 0 | 86 |
| 5 | 1 | 20 | 2 | 52 | 4 | 58 | 8 | 35 | 18 | 1 | 90 | 0 | 85 |
| 6 | 1 | 36 | 3 | 27 | 5 | 58 | 10 | 16 | 21 | 19 | 90 | 0 | 84 |
| 7 | 1 | 52 | 4 | 3 | 6 | 57 | 11 | 55 | 24 | 27 | 90 | 0 | 83 |
| 8 | 2 | 8 | 4 | 37 | 7 | 55 | 13 | 33 | 27 | 23 | 90 | 0 | 82 |
| 9 | 2 | 23 | 5 | 9 | 8 | 54 | 15 | 10 | 30 | 17 | 90 | 0 | 81 |
| 10 | 2 | 40 | 5 | 43 | 9 | 51 | 16 | 44 | 32 | 55 | 90 | 0 | 80 |
| 11 | 2 | 55 | 6 | 17 | 10 | 48 | 18 | 17 | 35 | 27 | 90 | 0 | 79 |
| 12 | 3 | 11 | 6 | 51 | 11 | 45 | 19 | 40 | 37 | 49 | 90 | 0 | 78 |
| 13 | 3 | 27 | 7 | 24 | 12 | 41 | 21 | 17 | 40 | 1 | 90 | 0 | 77 |
| 14 | 3 | 43 | 7 | 57 | 13 | 36 | 22 | 44 | 42 | 4 | 90 | 0 | 76 |
| 15 | 3 | 58 | 8 | 30 | 14 | 31 | 24 | 0 | 44 | 0 | 90 | 0 | 75 |
| 16 | 4 | 13 | 9 | 2 | 15 | 25 | 25 | 31 | 45 | 49 | 90 | 0 | 74 |
| 17 | 4 | 29 | 9 | 35 | 16 | 26 | 26 | 52 | 47 | 27 | 90 | 0 | 73 |
| 18 | 4 | 44 | 10 | 8 | 10 | 10 | 28 | 9 | 49 | 4 | 90 | 0 | 72 |
| 19 | 4 | 59 | 10 | 39 | 18 | 2 | 29 | 25 | 50 | 33 | 90 | 0 | 71 |
| 20 | 5 | 14 | 11 | 10 | 18 | 53 | 30 | 39 | 51 | 55 | 90 | 0 | 70 |
| 21 | 5 | 29 | 11 | 41 | 19 | 44 | 31 | 50 | 53 | 9 | 90 | 0 | 69 |
| 22 | 5 | 44 | 12 | 12 | 20 | 32 | 32 | 58 | 54 | 21 | 90 | 0 | 68 |
| 23 | 5 | 59 | 12 | 43 | 21 | 20 | 34 | 5 | 55 | 30 | 90 | 0 | 67 |
| 24 | 6 | 14 | 13 | 13 | 22 | 8 | 35 | 10 | 56 | 37 | 90 | 0 | 66 |
| 25 | 6 | 28 | 13 | 43 | 22 | 55 | 36 | 12 | 57 | 34 | 90 | 0 | 65 |
| 26 | 6 | 42 | 14 | 12 | 23 | 40 | 37 | 13 | 58 | 34 | 90 | 0 | 64 |
| 27 | 6 | 56 | 14 | 41 | 24 | 25 | 38 | 11 | 59 | 27 | 90 | 0 | 63 |
| 28 | 7 | 10 | 15 | 10 | 25 | 9 | 39 | 7 | 60 | 17 | 90 | 0 | 62 |
| 29 | 7 | 24 | 15 | 40 | 25 | 52 | 40 | 2 | 61 | 4 | 90 | 0 | 61 |
| 30 | 7 | 38 | 16 | 6 | 26 | 33 | 40 | 54 | 61 | 49 | 90 | 0 | 60 |

Hor. Dial Lat.

TABLE IV.

A TABLE of *Meridional Angles*.

South Dial Lat.

| | XI | | I | | X | | II | | IX | | III | | VIII | | IV | | VII | | V | | VI | | |
|----|----|----|----|----|----|----|----|----|----|----|-----|----|------|----|----|----|-----|----|----|----|----|----|----|
| | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | |
| 31 | 7 | 50 | 16 | 34 | 27 | 15 | 41 | 44 | 62 | 30 | 90 | 0 | 59 | | | | | | | | | | 59 |
| 32 | 8 | 5 | 17 | 1 | 27 | 55 | 42 | 30 | 63 | 11 | 90 | 0 | 58 | | | | | | | | | | 58 |
| 33 | 8 | 19 | 17 | 27 | 28 | 34 | 43 | 20 | 63 | 49 | 90 | 0 | 57 | | | | | | | | | | 57 |
| 34 | 8 | 31 | 17 | 54 | 29 | 13 | 44 | 5 | 64 | 24 | 90 | 0 | 56 | | | | | | | | | | 56 |
| 35 | 8 | 44 | 18 | 20 | 29 | 50 | 44 | 49 | 64 | 58 | 90 | 0 | 55 | | | | | | | | | | 55 |
| 36 | 8 | 57 | 18 | 49 | 30 | 27 | 45 | 31 | 65 | 30 | 90 | 0 | 54 | | | | | | | | | | 54 |
| 37 | 9 | 10 | 19 | 9 | 31 | 2 | 46 | 12 | 66 | 10 | 90 | 0 | 53 | | | | | | | | | | 53 |
| 38 | 9 | 22 | 19 | 34 | 31 | 37 | 46 | 50 | 66 | 29 | 90 | 0 | 52 | | | | | | | | | | 52 |
| 39 | 9 | 34 | 19 | 58 | 32 | 11 | 47 | 28 | 66 | 56 | 90 | 0 | 51 | | | | | | | | | | 51 |
| 40 | 9 | 45 | 20 | 21 | 32 | 44 | 48 | 7 | 67 | 21 | 90 | 0 | 50 | | | | | | | | | | 50 |
| 41 | 9 | 57 | 20 | 44 | 33 | 16 | 48 | 39 | 67 | 47 | 90 | 0 | 49 | | | | | | | | | | 49 |
| 42 | 10 | 10 | 21 | 7 | 33 | 46 | 49 | 12 | 68 | 11 | 90 | 0 | 48 | | | | | | | | | | 48 |
| 43 | 10 | 22 | 21 | 29 | 34 | 18 | 49 | 44 | 68 | 33 | 90 | 0 | 47 | | | | | | | | | | 47 |
| 44 | 10 | 32 | 21 | 51 | 34 | 47 | 50 | 10 | 68 | 54 | 90 | 0 | 46 | | | | | | | | | | 46 |
| 45 | 10 | 44 | 22 | 12 | 35 | 17 | 50 | 46 | 69 | 15 | 90 | 0 | 45 | | | | | | | | | | 45 |
| 46 | 10 | 54 | 22 | 33 | 35 | 44 | 51 | 15 | 69 | 35 | 90 | 0 | 44 | | | | | | | | | | 44 |
| 47 | 11 | 5 | 22 | 53 | 36 | 11 | 51 | 42 | 69 | 53 | 90 | 0 | 43 | | | | | | | | | | 43 |
| 48 | 11 | 16 | 23 | 13 | 36 | 37 | 52 | 9 | 70 | 11 | 90 | 0 | 42 | | | | | | | | | | 42 |
| 49 | 11 | 25 | 23 | 33 | 37 | 3 | 52 | 35 | 70 | 28 | 90 | 0 | 41 | | | | | | | | | | 41 |
| 50 | 11 | 35 | 23 | 52 | 37 | 28 | 53 | 0 | 70 | 43 | 90 | 0 | 40 | | | | | | | | | | 40 |
| 51 | 11 | 45 | 24 | 9 | 37 | 52 | 53 | 24 | 70 | 59 | 90 | 0 | 39 | | | | | | | | | | 39 |
| 52 | 11 | 55 | 24 | 27 | 38 | 15 | 53 | 46 | 71 | 13 | 90 | 0 | 38 | | | | | | | | | | 38 |
| 53 | 12 | 5 | 24 | 43 | 38 | 37 | 54 | 12 | 71 | 28 | 90 | 0 | 37 | | | | | | | | | | 37 |
| 54 | 12 | 13 | 25 | 2 | 38 | 58 | 54 | 29 | 71 | 41 | 90 | 0 | 36 | | | | | | | | | | 36 |
| 55 | 12 | 22 | 25 | 18 | 39 | 19 | 54 | 49 | 71 | 54 | 90 | 0 | 35 | | | | | | | | | | 35 |
| 56 | 12 | 32 | 25 | 34 | 39 | 40 | 55 | 9 | 72 | 5 | 90 | 0 | 34 | | | | | | | | | | 34 |
| 57 | 12 | 40 | 25 | 50 | 39 | 50 | 55 | 28 | 72 | 17 | 90 | 0 | 33 | | | | | | | | | | 33 |
| 58 | 12 | 45 | 26 | 5 | 40 | 1 | 55 | 45 | 72 | 28 | 90 | 0 | 32 | | | | | | | | | | 32 |
| 59 | 12 | 56 | 26 | 20 | 40 | 36 | 56 | 3 | 72 | 38 | 90 | 0 | 31 | | | | | | | | | | 31 |
| 60 | 13 | 4 | 26 | 34 | 40 | 54 | 56 | 19 | 72 | 48 | 90 | 0 | 30 | | | | | | | | | | 30 |

TABLE IV.

A TABLE of *Meridional Angles.*

| Lat. | XI | | I | | X | | II | | IX | | III | | VIII | | IV | | VII | | V | | IV | | Lat. |
|------|----|----|----|----|----|----|----|----|----|----|-----|----|------|----|----|----|-----|----|----|----|----|----|------|
| | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | |
| 61 | 13 | 11 | 26 | 47 | 41 | 10 | 56 | 34 | 72 | 58 | 90 | 0 | 29 | 29 | | | | | | | | | |
| 62 | 13 | 19 | 27 | 1 | 41 | 21 | 56 | 49 | 73 | 7 | 90 | 0 | 28 | 28 | | | | | | | | | |
| 63 | 13 | 26 | 27 | 13 | 41 | 42 | 57 | 3 | 73 | 15 | 90 | 0 | 27 | 27 | | | | | | | | | |
| 64 | 13 | 32 | 27 | 25 | 41 | 57 | 57 | 17 | 73 | 24 | 90 | 0 | 26 | 26 | | | | | | | | | |
| 65 | 13 | 36 | 27 | 37 | 42 | 15 | 57 | 30 | 73 | 32 | 90 | 0 | 25 | 25 | | | | | | | | | |
| 66 | 13 | 46 | 27 | 49 | 42 | 25 | 57 | 43 | 73 | 39 | 90 | 0 | 24 | 24 | | | | | | | | | |
| 67 | 13 | 51 | 27 | 59 | 42 | 38 | 57 | 54 | 73 | 46 | 90 | 0 | 23 | 23 | | | | | | | | | |
| 68 | 13 | 57 | 28 | 9 | 42 | 50 | 58 | 5 | 73 | 53 | 90 | 0 | 22 | 22 | | | | | | | | | |
| 69 | 14 | 3 | 28 | 19 | 43 | 2 | 58 | 16 | 73 | 59 | 90 | 0 | 21 | 21 | | | | | | | | | |
| 70 | 14 | 7 | 28 | 29 | 43 | 13 | 58 | 26 | 74 | 5 | 90 | 0 | 20 | 20 | | | | | | | | | |
| 71 | 14 | 13 | 28 | 37 | 43 | 18 | 58 | 35 | 74 | 11 | 90 | 0 | 19 | 19 | | | | | | | | | |
| 72 | 14 | 18 | 28 | 46 | 43 | 24 | 58 | 44 | 74 | 16 | 90 | 0 | 18 | 18 | | | | | | | | | |
| 73 | 14 | 22 | 28 | 54 | 43 | 36 | 58 | 52 | 74 | 20 | 90 | 0 | 17 | 17 | | | | | | | | | |
| 74 | 14 | 27 | 29 | 2 | 43 | 52 | 59 | 00 | 74 | 25 | 90 | 0 | 16 | 16 | | | | | | | | | |
| 75 | 14 | 30 | 29 | 7 | 44 | 00 | 59 | 7 | 74 | 30 | 90 | 0 | 15 | 15 | | | | | | | | | |
| 76 | 14 | 33 | 29 | 15 | 44 | 8 | 59 | 15 | 74 | 34 | 90 | 0 | 14 | 14 | | | | | | | | | |
| 77 | 14 | 37 | 29 | 21 | 44 | 14 | 59 | 22 | 74 | 37 | 90 | 0 | 13 | 13 | | | | | | | | | |
| 78 | 14 | 41 | 29 | 27 | 44 | 22 | 59 | 27 | 74 | 40 | 90 | 0 | 12 | 12 | | | | | | | | | |
| 79 | 14 | 44 | 29 | 32 | 44 | 28 | 59 | 32 | 74 | 44 | 90 | 0 | 11 | 11 | | | | | | | | | |
| 80 | 14 | 47 | 29 | 37 | 44 | 34 | 59 | 37 | 74 | 47 | 90 | 0 | 10 | 10 | | | | | | | | | |
| 81 | 14 | 49 | 29 | 41 | 44 | 37 | 59 | 40 | 74 | 49 | 90 | 0 | 9 | 9 | | | | | | | | | |
| 82 | 14 | 51 | 29 | 45 | 44 | 40 | 59 | 44 | 74 | 51 | 90 | 0 | 8 | 8 | | | | | | | | | |
| 83 | 14 | 53 | 29 | 49 | 44 | 44 | 59 | 47 | 74 | 53 | 90 | 0 | 7 | 7 | | | | | | | | | |
| 84 | 14 | 55 | 29 | 52 | 44 | 48 | 59 | 51 | 74 | 55 | 90 | 0 | 6 | 6 | | | | | | | | | |
| 85 | 14 | 56 | 29 | 54 | 44 | 53 | 59 | 54 | 74 | 57 | 90 | 0 | 5 | 5 | | | | | | | | | |
| 86 | 14 | 57 | 29 | 55 | 44 | 55 | 59 | 55 | 74 | 58 | 90 | 0 | 4 | 4 | | | | | | | | | |
| 87 | 14 | 58 | 29 | 56 | 44 | 56 | 59 | 56 | 74 | 58 | 90 | 0 | 3 | 3 | | | | | | | | | |
| 88 | 14 | 59 | 29 | 57 | 44 | 57 | 59 | 58 | 74 | 59 | 90 | 0 | 2 | 2 | | | | | | | | | |
| 89 | 14 | 59 | 29 | 58 | 44 | 58 | 59 | 59 | 74 | 59 | 90 | 0 | 1 | 1 | | | | | | | | | |
| 90 | 15 | 00 | 30 | 00 | 45 | 00 | 60 | 00 | 75 | 00 | 90 | 0 | 0 | 0 | | | | | | | | | |

THE Explanation and Use

Of the foregoing

T A B L E.

THIS is a Table of *Meridional Angles*; the *first Column* is the *Latitude*, which serves for an *Horizontal Dial*, and the *last Column* is the *Complement of the Latitude*, and is for making *Erect Direct* SOUTH, or NORTH Dials, and are thus to be used:  Suppose in the *Latitude* of 53 *Deg.* I would make an *Horizontal*, and also an *Erect Direct* South Dial.

First, *For the Horizontal Dial.*

See Plate 3. Fig. 2.

Now (altho' this be projected for a *higher* Concerning Latitude, yet it may serve our Turn here an Hori- well enough to shew how to use the Table :) zontal I look into the Table and find against 53 Dial. *Deg.* and under 11 and 1 a-clock 12 *Deg.* 5 *Min.* Take this 12 *Deg.* 5 *Min.* in your Compasses (from *the Line of Chords*, that
H 3 you

you draw the *Quadrant* A B by) and set one foot in the *Meridian* C A, and turning the *other* each Way, it shall give the *Points* where the *Hour Lines* of 1 and 11 must pass; under 10 and 2: and against the *same Latitude* 53, I find 24 Deg. 43 Min. which take from the *Line of Chords*, and set each Way from the *Meridian* as before, and it gives the 10 and 2 a-clock *Hour Lines*. For the Hours 9 and 3 you must take 38 Deg. 37 Min. for 8 and 4 a-clock, you must set 54 Deg. 12 Min. and for 5 and 7 set 71 Deg. 28 Min. the *Chord* of 90 gives the 6 a-clock *Hour Line*, and so by drawing *Hour Lines* from the Center thro' these *Points*, thus set off in the *Arch* A B, are the true *Hour Lines* required.

Secondly, *For the Erect Direct South Dial.*

See Plate 4. Fig. 2.

Concerning
an Erect
Direct
South
Dial.

Suppose I would make an *Erect Direct South Dial* for the *Latitude* of 53 Deg. the Work in this is the very same as I have shewed in the *Horizontal Dial*; only here you must seek your *Latitude* in the last Column on the *right Hand*, or its *Complement* on the *left Hand*; and against either, for 11 and 1 a-clock, 9 Deg. 10 Min. for 10 and 2, 19 Deg. 9 Min. are to be set off from the *Meridian* by your *Line of Chords*; from 9
and

and 3 a-clock are 31 *Deg.* 2 *Min.* for 8 and 4 a-clock are 46 *Deg.* 12 *Min.* for 7 and 5 a-clock are 66 *Deg.* 10 *Min.* and for 6 a-clock are 90; and thus for any *Latitude* of *even Degrees*, an *Horizontal* and *South Direct Dial* may be expeditiously made by help of this *Table* and your *Line of Chords*.

What has been said of the *South Erect Dial* is also applicable to the *North*, and therefore needs no Example.



H 4

TABLE

TABLE V.

A TABLE of the *Three Requisites* in *Dialling*, shewing the *Substyle's Distance* from the *Meridian*, the *Style's Height*, and the *Inclination of Meridians* for the *Latitude of London*; answerable to the several *Degrees of Declination* of your *Plane*.

N. B. *How to find* these *Requisites* for any other *Place*, is shewn in *Chap. XI*.

TABLE V.

A TABLE of the *Three Requisites* in *Dialling*.

| Declination. | Substyle's Distance from the Meridian. | | Style's Height. | Inclination of Meridians. | |
|--------------|--|----------|-----------------|---------------------------|----------|
| Degrees. | Degrees. | Minutes. | Deg. Min. | Degrees. | Minutes. |
| 1 | 0 | 48 | 38 29 | 1 | 17 |
| 2 | 1 | 36 | 38 28 | 2 | 33 |
| 3 | 2 | 23 | 38 26 | 3 | 49 |
| 4 | 3 | 11 | 38 23 | 5 | 7 |
| 5 | 3 | 58 | 38 20 | 6 | 23 |
| 6 | 4 | 45 | 38 15 | 7 | 39 |
| 7 | 5 | 32 | 38 10 | 8 | 55 |
| 8 | 6 | 19 | 38 4 | 10 | 11 |
| 9 | 7 | 5 | 37 57 | 11 | 27 |
| 10 | 7 | 52 | 37 49 | 12 | 42 |
| 11 | 8 | 38 | 37 40 | 13 | 57 |
| 12 | 9 | 23 | 37 30 | 15 | 10 |
| 13 | 10 | 8 | 37 21 | 16 | 26 |
| 14 | 10 | 54 | 37 10 | 17 | 40 |
| 15 | 11 | 38 | 36 58 | 18 | 54 |
| 16 | 12 | 22 | 36 43 | 20 | 7 |
| 17 | 13 | 5 | 36 32 | 21 | 20 |
| 18 | 13 | 42 | 36 18 | 22 | 33 |
| 19 | 14 | 31 | 36 3 | 23 | 45 |
| 20 | 15 | 13 | 35 48 | 24 | 57 |
| 21 | 15 | 54 | 35 31 | 26 | 8 |
| 22 | 16 | 36 | 35 16 | 27 | 18 |
| 23 | 17 | 16 | 34 57 | 28 | 29 |
| 24 | 17 | 56 | 34 39 | 29 | 38 |
| 25 | 18 | 37 | 34 21 | 30 | 47 |

TABLE V.

A TABLE of the *Three Requisites* in *Dialling*.

| Declination. | Substyle's Distance from the Meridian. | | Style's Height. | | Inclination of Meridians. | |
|--------------|--|----------|-----------------|------|---------------------------|----------|
| | Degrees. | Minutes. | Deg. | Min. | Degrees. | Minutes. |
| 26 | 19 | 12 | 34 | 1 | 31 | 56 |
| 27 | 19 | 50 | 33 | 42 | 33 | 4 |
| 28 | 20 | 27 | 33 | 20 | 34 | 12 |
| 29 | 21 | 5 | 32 | 59 | 35 | 19 |
| 30 | 21 | 40 | 32 | 37 | 36 | 25 |
| 31 | 22 | 15 | 32 | 15 | 37 | 31 |
| 32 | 22 | 50 | 31 | 52 | 38 | 36 |
| 33 | 23 | 25 | 31 | 27 | 39 | 41 |
| 34 | 23 | 59 | 31 | 4 | 40 | 46 |
| 35 | 24 | 31 | 30 | 40 | 41 | 49 |
| 36 | 25 | 4 | 30 | 14 | 42 | 52 |
| 37 | 25 | 35 | 29 | 48 | 43 | 55 |
| 38 | 26 | 4 | 29 | 22 | 44 | 58 |
| 39 | 26 | 35 | 28 | 56 | 45 | 59 |
| 40 | 27 | 3 | 28 | 29 | 47 | 0 |
| 41 | 27 | 33 | 28 | 1 | 48 | 0 |
| 42 | 28 | 1 | 27 | 33 | 49 | 0 |
| 43 | 28 | 29 | 27 | 5 | 50 | 0 |
| 44 | 28 | 55 | 26 | 36 | 50 | 59 |
| 45 | 29 | 21 | 26 | 7 | 51 | 57 |
| 46 | 29 | 46 | 25 | 37 | 52 | 55 |
| 47 | 30 | 11 | 25 | 7 | 53 | 53 |
| 48 | 30 | 35 | 24 | 38 | 54 | 50 |
| 49 | 30 | 58 | 24 | 6 | 55 | 46 |
| 50 | 31 | 21 | 23 | 35 | 56 | 42 |

T A B L E V.

A T A B L E of the *Three Requisites* in *Dialling*.

| Declination. | Substyle's Distance from the Meridian. | | Style's Height. | Inclination of Meridians. | |
|--------------|--|----------|-----------------|---------------------------|----------|
| Degrees. | Degrees. | Minutes. | Deg. Min. | Degrees. | Minutes. |
| 51 | 31 | 45 | 23 4 | 57 | 38 |
| 52 | 32 | 5 | 22 32 | 58 | 33 |
| 53 | 32 | 26 | 22 00 | 59 | 28 |
| 54 | 32 | 46 | 21 28 | 60 | 23 |
| 55 | 33 | 6 | 20 55 | 61 | 17 |
| 56 | 33 | 24 | 20 22 | 62 | 10 |
| 57 | 33 | 42 | 19 49 | 63 | 4 |
| 58 | 34 | 0 | 19 16 | 63 | 57 |
| 59 | 34 | 13 | 18 42 | 64 | 49 |
| 60 | 34 | 33 | 18 6 | 65 | 41 |
| 61 | 34 | 47 | 17 34 | 66 | 33 |
| 62 | 35 | 5 | 17 0 | 67 | 24 |
| 63 | 35 | 18 | 16 25 | 68 | 16 |
| 64 | 35 | 32 | 15 50 | 69 | 7 |
| 65 | 35 | 45 | 15 15 | 69 | 57 |
| 66 | 36 | 00 | 14 40 | 70 | 47 |
| 67 | 36 | 13 | 14 5 | 71 | 38 |
| 68 | 36 | 25 | 13 29 | 72 | 27 |
| 69 | 36 | 36 | 12 53 | 73 | 16 |
| 70 | 36 | 45 | 12 11 | 74 | 6 |

TABLE V.

T A B L E V.

A T A B L E of the *Three Requisites* in *Dialling*.

| Declination. | Substyle's Distance from the Meridian. | | Style's Height. | | Inclination of Meridians. | |
|--------------|--|----------|-----------------|------|---------------------------|----------|
| Degrees. | Degrees. | Minutes. | Deg. | Min. | Degrees. | Minutes. |
| 71 | 36 | 55 | 11 | 41 | 74 | 55 |
| 72 | 37 | 6 | 11 | 6 | 75 | 44 |
| 73 | 37 | 15 | 10 | 29 | 76 | 33 |
| 74 | 37 | 24 | 9 | 53 | 77 | 21 |
| 75 | 37 | 32 | 9 | 16 | 78 | 9 |
| 76 | 37 | 40 | 8 | 40 | 78 | 57 |
| 77 | 37 | 47 | 8 | 3 | 79 | 46 |
| 78 | 37 | 53 | 7 | 27 | 80 | 33 |
| 79 | 37 | 59 | 6 | 49 | 81 | 21 |
| 80 | 38 | 4 | 6 | 12 | 82 | 00 |
| 81 | 38 | 9 | 5 | 35 | 82 | 36 |
| 82 | 38 | 14 | 4 | 58 | 83 | 43 |
| 83 | 38 | 17 | 4 | 20 | 84 | 31 |
| 84 | 38 | 21 | 3 | 44 | 85 | 18 |
| 85 | 38 | 23 | 3 | 6 | 86 | 5 |
| 86 | 38 | 26 | 2 | 28 | 86 | 52 |
| 87 | 38 | 28 | 1 | 52 | 87 | 39 |
| 88 | 38 | 29 | 1 | 15 | 88 | 26 |
| 89 | 38 | 29 | 0 | 37 | 89 | 13 |
| 90 | 38 | 30 | 0 | 00 | 90 | 00 |

THE

T H E

Explanation and Use

Of the foregoing

T A B L E.

L *Asly*, The Table of the *Three Re-*
quisites in Dialling is explained in
 Chap. XI, where I have shewn how to
 find the *Substyle's Distance* from the *Meri-*
dian, the *Style's height*, and the *Inclination*
of Meridians for *Latitude 53 Deg. 22 Min.*
 and the *Plane's Declination 21 Deg. 10 Min.*
West, which may serve as a *standing Rule*
 for any other *Latitude* and *Declination*
 whatsoever.

TABLE

TABLE VI.

A TABLE shewing the *Sun's*
Altitude every *Hour* and
Quarter of the *Day* at his
Entrance into the 12 *Signs*
of the *Zodiack* for the *La-*
titude of *London*.

N. B. *This Table is useful in*
drawing Reflective Dials.

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A TABLE shewing the *Sun's Altitude* every *Hour and Quarter* of the Day, at his Entrance into the 12 *Signs of the Zodiack* in the *Latitude of London* 51 *Deg. 32 Min. North.*

| Hours | ♈ | ♉ | ♊ | ♋ | ♌ | ♍ | ♎ | ♏ | ♐ | ♑ | ♒ | ♓ | ♈ | ♉ | ♊ | ♋ | ♌ | ♍ | ♎ | ♏ | ♐ | ♑ | ♒ | ♓ |
|---------|
| | M. | D. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. | D. | M. |
| XII | 61 | 57 | 58 | 39 | 49 | 58 | 38 | 28 | 26 | 58 | 18 | 17 | 14 | 59 | | | | | | | | | | |
| 1 | 61 | 48 | 58 | 34 | 49 | 52 | 38 | 22 | 26 | 52 | 18 | 10 | 14 | 52 | | | | | | | | | | |
| 2 | 61 | 22 | 58 | 8 | 49 | 32 | 38 | 4 | 26 | 37 | 17 | 56 | 14 | 39 | | | | | | | | | | |
| 3 | 60 | 39 | 57 | 27 | 48 | 57 | 37 | 36 | 26 | 12 | 17 | 34 | 14 | 18 | | | | | | | | | | |
| I XI | 59 | 42 | 56 | 33 | 48 | 10 | 36 | 56 | 25 | 37 | 17 | 3 | 13 | 48 | | | | | | | | | | |
| 1 | 58 | 29 | 55 | 25 | 47 | 11 | 36 | 5 | 24 | 53 | 16 | 24 | 13 | 9 | | | | | | | | | | |
| 2 | 57 | 4 | 54 | 6 | 46 | 1 | 35 | 4 | 24 | 1 | 15 | 36 | 12 | 23 | | | | | | | | | | |
| 3 | 55 | 29 | 52 | 34 | 44 | 40 | 33 | 58 | 22 | 59 | 14 | 19 | 11 | 29 | | | | | | | | | | |
| II X | 53 | 45 | 50 | 55 | 43 | 11 | 32 | 36 | 21 | 49 | 13 | 36 | 10 | 28 | | | | | | | | | | |
| 1 | 51 | 53 | 49 | 7 | 41 | 52 | 31 | 8 | 20 | 31 | 12 | 24 | 9 | 19 | | | | | | | | | | |
| 2 | 49 | 54 | 47 | 12 | 39 | 47 | 29 | 34 | 19 | 6 | 11 | 6 | 8 | 3 | | | | | | | | | | |
| 3 | 47 | 51 | 45 | 13 | 37 | 57 | 27 | 53 | 17 | 36 | 9 | 42 | 6 | 41 | | | | | | | | | | |
| III IX | 15 | 42 | 43 | 7 | 35 | 59 | 26 | 5 | 15 | 57 | 8 | 11 | 5 | 13 | | | | | | | | | | |
| 1 | 43 | 31 | 40 | 58 | 33 | 57 | 24 | 12 | 14 | 13 | 6 | 34 | 3 | 39 | | | | | | | | | | |
| 2 | 41 | 15 | 38 | 45 | 31 | 49 | 22 | 25 | 12 | 23 | 4 | 51 | 1 | 59 | | | | | | | | | | |
| 3 | 38 | 59 | 36 | 30 | 29 | 40 | 20 | 13 | 10 | 30 | 3 | 5 | 0 | 15 | | | | | | | | | | |
| IV VIII | 36 | 40 | 34 | 14 | 27 | 28 | 18 | 7 | 8 | 32 | 1 | 13 | | | | | | | | | | | | |
| 1 | 34 | 23 | 31 | 56 | 25 | 13 | 15 | 58 | 6 | 31 | | | | | | | | | | | | | | |
| 2 | 32 | 4 | 29 | 37 | 22 | 56 | 13 | 46 | 4 | 25 | | | | | | | | | | | | | | |
| 3 | 29 | 43 | 27 | 16 | 20 | 37 | 11 | 32 | 2 | 16 | | | | | | | | | | | | | | |
| V VII | 27 | 23 | 24 | 56 | 18 | 18 | 9 | 17 | 0 | 5 | | | | | | | | | | | | | | |
| 1 | 25 | 4 | 22 | 37 | 15 | 59 | 6 | 58 | | | | | | | | | | | | | | | | |
| 2 | 22 | 46 | 20 | 17 | 13 | 39 | 4 | 39 | | | | | | | | | | | | | | | | |
| 3 | 20 | 28 | 17 | 57 | 11 | 19 | 2 | 20 | | | | | | | | | | | | | | | | |
| VI VI | 18 | 12 | 15 | 42 | 9 | 6 | | | | | | | | | | | | | | | | | | |
| 1 | 15 | 58 | 14 | 0 | 6 | 44 | | | | | | | | | | | | | | | | | | |
| 2 | 13 | 46 | 11 | 13 | 4 | 22 | | | | | | | | | | | | | | | | | | |
| 3 | 11 | 37 | 9 | 1 | 2 | 8 | | | | | | | | | | | | | | | | | | |
| VII V | 9 | 30 | 6 | 52 | |
| 1 | 7 | 25 | 4 | 46 | |
| 2 | 5 | 24 | 2 | 42 | |
| 3 | 3 | 27 | 0 | 43 | |
| VIII IV | 1 | 34 | |

T H E
Explanation and Use
 Of the foregoing
T A B L E.

THIS Table shews the *Sun's Height* or *Altitude* at every *Hour and Quarter* of the Day, for the *Latitude* of *London*, and is useful in drawing *Hour Lines* upon your *Quadrant* *, and also for drawing the *Hour Lines* upon the *Cieling* of your Room in the *Reflective Dial*, and by your *Quadrant* you may find the *Sun's Altitude* at any *Time* of the Day wherever you are, by holding your *Quadrant* up and looking through the *Sights* at the *Sun*, and the *Thread* will cut the *Limb*, or *Arch* of the *Quadrant* in the *Degrees* of the *Sun's height* at that *Time and Place*; the *Minutes* must be guessed at, because every *Degree* being supposed to be divided into 60 equal *Parts* called *Minutes*, and those *Divisions* called *Degrees* being small, it is impossible they should actually be divided into *Minutes* or 60 equal *Parts*, so that if the *Thread* cuts a *Quarter* of a *Degree*, then call the *Minutes* 15, if it cut one *Third* of a *Degree*, call them 20 *Minutes*, if a *half* 30, if *two Thirds* 40, if *three Fourths*, then the *Minutes* are 45, &c. and thus you may take the *Height* of the *Moon* and *Stars*. And by this means may you make the like Table for your own or any other *Latitude*.
 CHAP.

* For further Satisfaction herein you may see my *System of Astronomy*, Vol. I. page 111.

CHAP. XX.

Shewing the Use of the Scales in
Plate II.

IN *Prob.* 9, 10, 11 and 12, I have shewn how to make the *Scales* in *Plate II*, and in *Chap.* XVI. *Page* 72, I have shewn how to use the *Line of Chords*, in measuring of any right lined *Angles*; The *Lines of Hours* and *Latitudes* are general for pricking down all *Dials with Centers*, as the *Horizontal, South Direct*, &c. as for

Of the
Lines of
Hours and
of the
Lines of
Latitude.

Example.

Let it be required to draw a *Dial* upon an *Horizontal Plane* for the *Latitude* of *London* 51 Deg. 32 Min.

See *Plate* 11. *Fig.* 1.

For the *Hour Lines* and *Style's height*.

Draw *CD* for the *Meridian*, or *Hour Line* of 12, and cross it at right *Angles* in *C*, with *AB*; then from the *Scale of Latitudes*, set off *CA* and *CB* each equal to 51 Deg. 32 Min. for the *Style's height*. Then take the whole *Scale of Six Hours* in your *Compasses*,

For the
Hour
Lines.

114 *Of the Use of the Scales in Plate II.*

CHAP. passes, and set it from A to D; draw A D
 XX. and B D: *Divide* the Lines A D and B D
 as the *Scale of Six Hours* is divided, and
 thro' those *Divisions* draw Lines to the Center
 C, which shall be the true *Hour Lines* sought,
 to which put their *proper Figures* as you
 see done in the Dial.

This is a very ready and easy way to describe the *Hour Lines* on any Plane.

For the Style.

Take C A in your Compasses, and set from D to E, draw C E for the *Style*, which must stand *perpendicular* upon the Line C D, and so is your Dial compleatly finished.

Ever remember to make an Allowance for the *Thickness* of the *Style* in all Dials, as I have cautioned you before.

An Example.

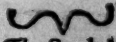
Of a
 North
 and South
 Direct
 Dial for
 Penzance
 in Corn-
 wall.

Of a *North* and *South* Erect Direct Dial for *Penzance* in *Cornwall*, whose *Latitude* is 50 Deg. 8 Min. N.

See Plate II. Fig. 2.

This Dial is made the very same Way as I have just now shewn in the *Horizontal Dial*, only instead of taking the *Latitude* from the *Scale of Latitudes*, you must here
 2 in

Of the Use of the Scales in Plate II. 115

in this Dial take the *Complement of the Latitude of the Place*, viz. 39 Deg. 52 Min. XX. and set it from C to A, and B, which is also the *Style's height*.  *The Style's height.*

For the Hour Lines of the South and North Dials.

Take the *Scale of Six Hours*, and set from A to D, draw A D and B D, then take in your *Compasses each Hour severally* from the *Scale of Six Hours*, and mark them off in the Lines A D and B D; thro' those Points, draw Lines from the Center C, and they shall be the *true Hour Lines* required.

For the Style.

Set A C from D to E, and continue it beyond the Center C, which shall be the *Styles* for the *North* and *South* Dial, as you see done in the Dials.

By the *Scale of Inclinations* is known in *Of the erect Decliners*, where the *Substyler Line* *Scale of Inclinations.* will fall; which must always be on the *contrary Side*, the *Meridian Line* or *Hour Line* of 12; that is, if the Plane declines *Westward* the *Substyler Line* must stand on the *East side*, but if the Plane decline *Eastward*, then the *Substyler Line* must be placed on the *West side* the *Meridian*: and if the *Inclination*

116 *Of the Use of the Scales in Plate II.*

CHAP. *clination of Meridians be less than 15 Deg.*

XX. *the Substylar Line will fall between 11 and*

12, or between 12 and one a-clock, according to which Point of the Heavens the Plane declines: if the Inclinations of Meri-

dians be more than 15 Deg. but less than 30 the Substylar Line will fall between the Hours of one and two, &c. Some Dialists put the Difference of Meridians of several Places, as Jerusalem, Madrid, &c. upon the Dial to shew the Time of the Day at those Places, as well as the Time where you are; but this is needless; for if at any Time you would know what a-clock it is at any Place in the known World, when it is such a Time at London, only turn to the Table of the Latitude and Longitude of Places at the End of this Treatise, and there see what the Difference of Meridians is; and if the Place be to the East of London, add the Difference of Meridians in Time to the Time at London, which gives the Time at that Place; but if it lie to the West, subtracting the Difference of Meridians in Time from the Time at London, gives you the Time of the Day at that Place.

The Difference of Meridians of several Places unnecessarily put upon Dials.

How to find what a-clock in any part of the World.

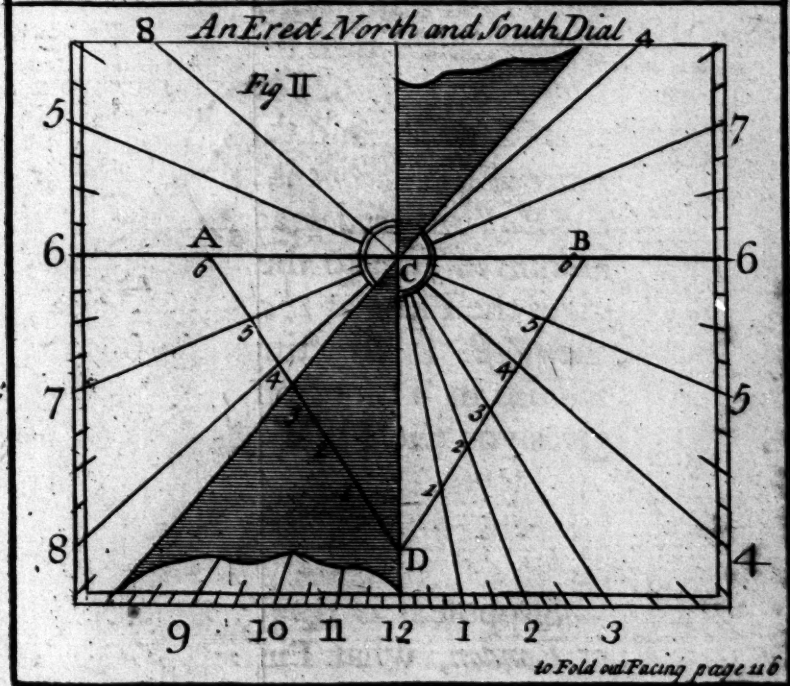
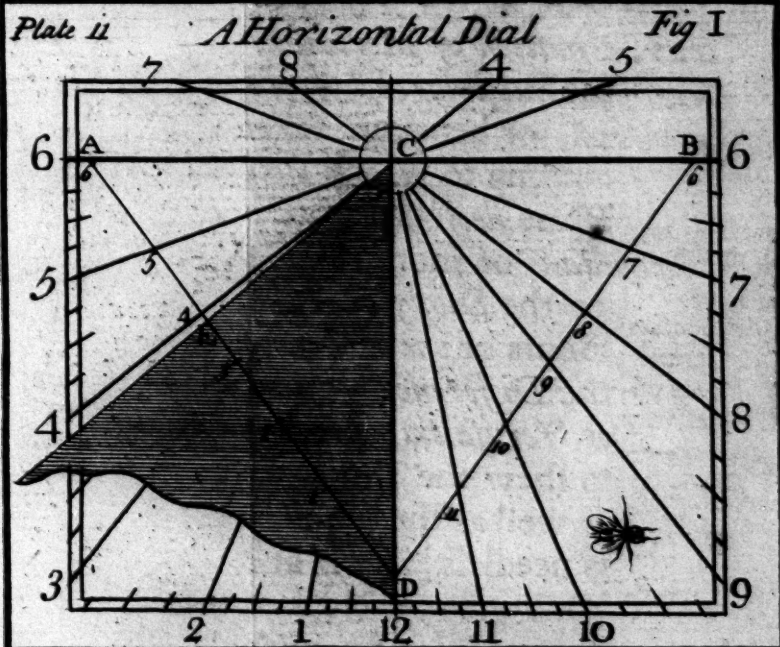
Example.

An Example of the Hours at London and Constantinople.

Suppose it is 10 a-clock in the Forenoon at London, what Time is it then at Constantinople, and also at Port Royal in Jamaica?

Given

These Dials are made by Scales in Plate 2



Of the Use of the Trigon.

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| | H. | M. | CHAP. |
|--|----|----|-------|
| Given Time at <i>London</i> is | 10 | 00 | XX. |
| <i>Constantinople</i> to the <i>East</i> (add) — | 1 | 59 | W |
| Time at <i>Constantinople</i> | 11 | 59 | |
| That is 59 Min. past Eleven in the Forenoon. | | | |

Again.

| | H. | M. | |
|---|----|----|--|
| Given Time at <i>London</i> is | 10 | 00 | |
| <i>Port Royal</i> to the <i>West</i> (subtract) | 5 | 4 | Of the Hours at London and Port Royal. |
| Time at <i>Port Royal</i> in the Morning | 4 | 56 | |

The like of any other Place in the Catalogue.

The Use of the TRIGON.

See the Figure on Page 13.

You are to take notice, that the *Parallels of the Signs*, the *Daily Arches*, the *Circles of Altitude*, and all other *Circles* relating to the *Course of the Sun*, when they are described upon any *Sun Dial*, are not shadowed out by the whole *Style*, or *Axis* of the *Dial* as the *Hours* are, but by some one *Point* in the same *Style* or *Axis*; as by a *Knob*, *Button*, or *Notch*, filed in the *Style* of the *Dial*; or by a *Hole* in a *Glass Window*

CHAP. for *projected Dials*; or by a *Piece of Looking-glass* for *reflected Dials*; in all which
 XX. Cafes the *Trigon* at C is to be applied, so that the *Line* thereof marked A B, must lie upon the *Style* of the *Dial*, or *parallel* to the *Axis* of the *World*, if it be an *Hole in a Window*, or *Piece of Looking-glass*: And now, the *Trigon* being thus placed with the *Equinoctial* C D $\vee$ *perpendicular to the Style*, the *Center* being always fixed upon the *Button* or *Notch*, or *Knob*, so that you may turn it about the *Axis*, as occasion shall require.

For the Equinoctial.

Now suppose you would insert the *Equinoctial* into any *Dial*, (for *one Rule serves for all Planes*.) First, put a *Thread* through the *little Hole* marked with $\bullet$ at $\vee$ and $\sphericalangle$, tying a *Knot* on the *Thread* that it slips not through the *Hole* in the *Trigon*; then put the *Center* C to the *Knob* in the *Style*, and the *Side* A B to the *Style itself*: This done, extend the *Thread* over the *Line* C D $\vee$ till it touch the *Dial Plane*; that *Point of touching* shall be *one Point* through which the *Equinoctial* is to be drawn upon the *Plane*: Then turning the *Trigon* about, still keeping the *Line* A B *parallel to the Style*, extend the *Thread* till it touch the *Dial Plane* in some other *Point*, and that shall be another

ther Point, through which the *Equinoctial* CHAP.
is to be drawn upon the Dial. XX.

And if your Dial be all but *one plain Superficies*, *two Points* will be sufficient to draw the *Equinoctial* by, it being a *great Circle* of the *Sphere*, and consequently a *right Line* upon all *plain Superficies*; but

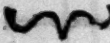
If the Dial consist of *more than one Plane*, then must you in the same manner as *before*, find *two Points at least* upon *each Superficies*; which you may easily and speedily do by turning the *Trigon* about the *Style*, and keeping the *Side A B parallel* thereto, extending the *Thread* over the *Line C D* & till it touch the *Plane*.

For the Tropick of Cancer.

In like manner if you would insert the *Tropick of Cancer* into your Dial, you must put the *Thread* in the *Hole* at $\mathfrak{C}$, and then apply the *Center C* to the *Knob* in the *Style* keeping the *Side A B parallel* to the *Style* (as before) extend the *Thread* over the *Line C* & till it touch the *Plane*, and that *Point* of touch must be *one Point* through which the *Tropick of Cancer* must pass.

Again move the *Trigon* in the *same Position*, upon the *Style of the Dial* as occasion requires; extend the *Thread* over the *Tropick C* & till it touch the *Plane*, and that shall be *another Point* through which the

CHAP. *Tropick* must be drawn, and in this manner

XX. may you find as many Points upon the Plane
 as you please, and *the more the better*, for
these Parallels will not be *streight Lines*, as
the *Equinoctial Line* was, but *conick* or
carved Lines, *through* which Points a Line
being traced, with an *even hand*, shall be
the *Tropick of Cancer* upon your Dial Plane.

For the Tropick of Capricorn.

And in this manner may the *Tropick of Capricorn*, and all the *Parallels* of the *other Signs* (or any other *Parallel* of the *Sun's Declination*) be drawn on your Dials, if first you put the *Thread* through the *respective Hole*, and apply the *Trigon* to the *Style*, and extend the *Thread* over the *Parallel of Declination* till it touch the Plane; and thus you may find as many Points as you please, thro' which to draw your *Parallels*, and this may suffice for the *Inscription* of the *Parallels* of the *Signs of the Zodiack*.

Of the
 Parallels
 of the
 length of
 Days,

And if you would insert the *Parallels* for the *length of the Day*, they are to be done in the same manner, if instead of the *Declinations for the Signs* you put into your *Trigon* the *Parallels* for the *length of the Days* you intend to insert into your Dial.

N. B. In Page 114 I have given a caution to all *Dialists*, that they be careful *always to make Allowance* for the *Thick-
 ness*

Of the Equinoctial Dial.

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ness of the Style, otherwise the Dial CHAP.
will err from the Truth. XXI.

C H A P. XXI.

A Review of the Equinoctial and Direct East and West Dials.

Of the Equinoctial Dial, after what is said concerning it in CHAP. III.

IF to this you add a *Semicircle* to represent *one half* of the *Meridian*, and graduate the *Meridian* unto *180 Deg.* by two *Ninety's*, and set it in a Notch over a Box and Needle well touched with the Load-stone, it will shew you the *Hour* of the *Day* wherever you be, as also the *Variation* of the *Needle* itself in that Place; for when you have set it to shew the *Hour*, if the *Needle* then lie *parallel* with the *Semicircle*, representing *one half* of the *Meridian*, it has then no *Variation*, but if it lies athwart with the *Meridian*, the *Angle* that it makes either to the *East* or *West* is the *Variation* of the *Needle* in that Place.

Some Properties of this Dial.

Of the Universality of this Dial.

It shews the Variation of the Needle.

N. B. It matters not whether you put any more *Hour Lines* upon the *Dial* than
are

What Hour Lines may be omitted.

CHAP. are useful in the Latitude where you are; as
 XXI. for instance at London you may omit the
 Hours after eight at Night till four in the
 Morning.

How nat-
 urally the
 Hour
 Lines of
 all Dials
 are drawn
 from the
 Equi-
 noctial
 Dial.

How naturally the *Hour Lines* may be drawn upon any Plane from the *Equinoctial Dial*, I shall here shew. Fix your *Style* to your Dial Plane in its right Position by help of your *Quadrant*, i. e. by applying the Edge thereof to the *Style*, and then the String cutting the Limb thereof in the Degrees of the Latitude of your Plane, because the Top of the *Style* is parallel to the *Earth's Axis*; and be careful also that it stand at right Angles to the $\perp$ *Substyler Line*, whatever Dial it be; then cut a slit quite thro' the *Equinoctial Dial* from the North edge to the Center along the 12 a-clock Line just so wide as to receive your *Style*; put this slit upon the *Style* of your Dial, so that the *Equinoctial Dial* may stand at right Angles thereto, for then doth it lie parallel to the Plane of the *Equinoctial* itself: From that Point where the *Equinoctial Dial* toucheth the *Style*, let fall a perpendicular upon the *Substyler Line*, this I call the *perpendicular height* of the *Style*; take this in your Compasses, and set one Foot in the *Substyler Line* where the *perpendicular height* of the *Style* touched it, and sweep a Circle; to this Circle draw a *Tangent Line* at right Angles to the *Substyler Line*;

Of the direct West Dial.

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Line; Lastly, Put a Thread in the Center CHAP. of the *Equinoctial Dial* (allowing for the XXI. Thickness of the Style) and stretch it over  the *Hour Lines*, and where the Thread toucheth the *Tangent Line* upon your Plane make Marks; and Lines drawn from the Center of your Dial to those Marks in the *Tangent Line* are the true *Hour Lines* upon your Dial: and this is a plain and ready way of drawing *Hour Lines* upon all Sorts of Planes.

A REVIEW of the direct West Dial after what is said concerning it in CHAP. VII, VIII.

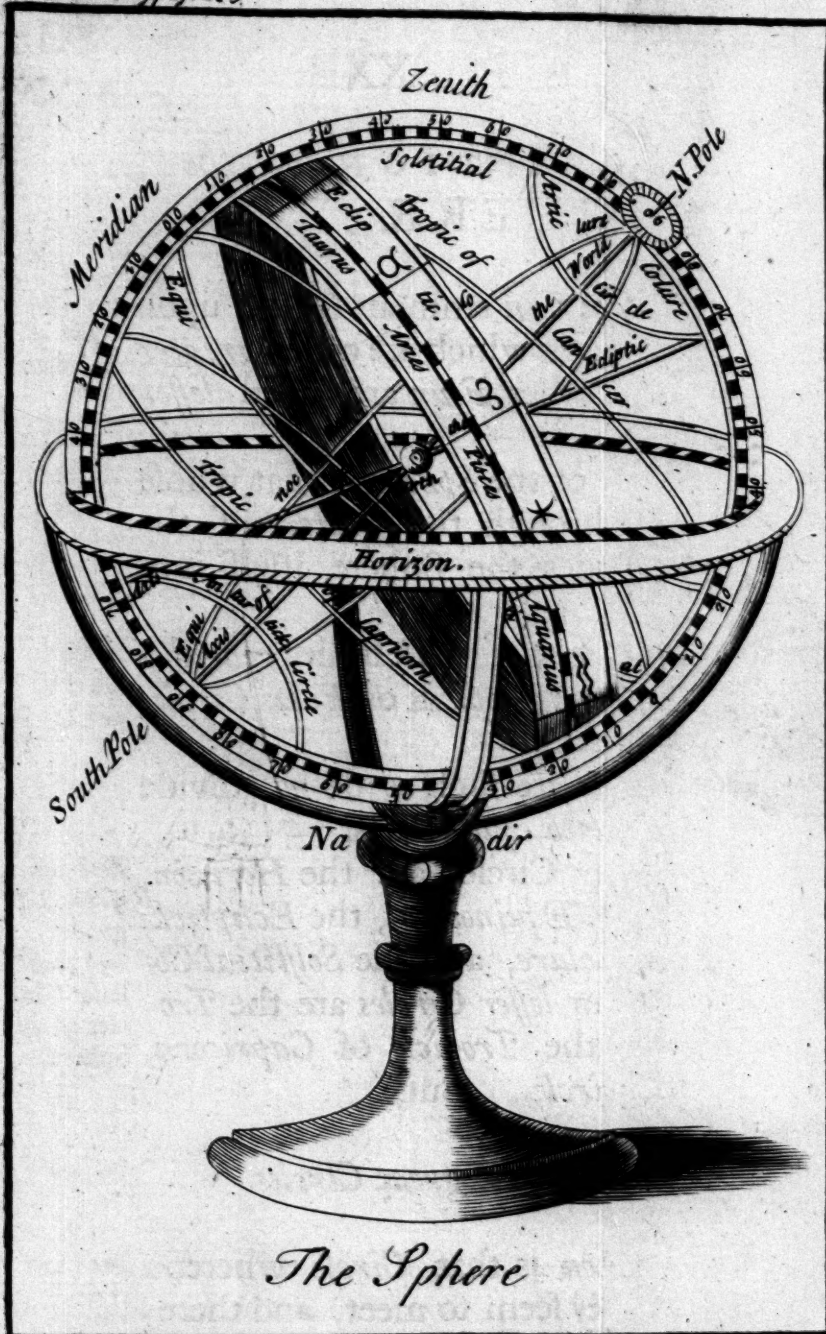
This Dial as well as the East Dial is universal, which I thus explain; procure a Some Curiosities concerning the Direct East and West Dials. Plate of Brass of what Size you please, and about the Thickness of a Shilling well polished on both Sides, on which draw an *East Dial* on *one Side* and a *West Dial* on the other, so that the Center of the Circle P H D S, on *one Side* may exactly answer the Center of the Circle on the *other Side*; let a Circle circumscribe your Dials, and the upper Quadrant divided into 90 equal Parts or Degrees; let there be a Ring in a swivel to screw to the *Zenith* of the Place wherever you be, after the manner of a Ring Dial; then hanging it on your Finger, placing its Plane parallel to the *Meridian* of the Place (which may

CHAP. may be done by help of a Magnetic Needle)
 XXI. it will shew you the true Hour of the Day,
 except it be exactly 12 a-clock, and then
 neither the *East* or *West* Side will shew the
 Hour, for the Shadow of the Styles do then
 fall off both the Planes.

These Things I mention as Curiosities,
 shewing how by keeping the Axis of your
 Dial parallel with the Axis of the World,
 the Dial by that means is universal, for un-
 der the *Arctic Pole* the Hour Line will be
perpendicular to the Horizon, and under the
Equinoctial they will become *parallel*, or
 lie in the Plane of that great Circle. But
 if under the *Equinoctial* you lay the Dial
 flat down, so that the Circle P H D S may
 represent the Horizon of that Place, and
 placing 12 where 6 now stands, one where
 5 is, &c. and 11 where 7 is, and 10 instead
 of 8, &c. to 6; this Dial will then repre-
 sent a *Polar* or *Equinoctial* Dial, which ever
 you please to call it.



to Fold out Facing page 125.



C H A P. XXII.

*A DESCRIPTION of the
SPHERE.*

THERE are *Ten* eminent *Circles* upon The Di-
vision of
the Sphere. Sphere; *Six* of which are called *greater
Circles*, and the other *Four* are called *lesser
Circles*.

A *great Circle* of the *Sphere* is that whose A great
Circle
what. *Plane* passeth through the *Center* of the *Sphere*, and divides the *Sphere* itself into *two equal Parts*.

A *lesser Circle* is that which lies *parallel* A lesser
Circle
what. to a *greater*, as the *Tropicks* or *Polar Circles* do to the *Equinoctial*.

Or *lesser Circles* are such as do *not* divide the *Sphere* into *two equal Parts*.

The *six greater Circles* are the *Horizon*, The Names
of the Six
greater
and four
lesser Cir-
cles of the
Sphere. the *Meridian*, the *Equinoctial*, the *Ecliptick*, the *Equinoctial Colure*, and the *Solstitial Colure*, and the *four lesser Circles* are the *Tropick of Cancer*, the *Tropick of Capricorn*, and the *Polar Circles*. But,

First, *Of the SIX great Circles.*

1. The *Horizon* is that *Circle* whereon The Ho-
rizon. the *Earth* and *Sky* seem to meet, and there-
fore when the *Sun*, *Moon*, and *Stars* come
to

CHAP. to the *East* thereof they are said to *Rise*,
 XXII. and when they come to the *West* thereof
 they are said to *Set*.

The Meridian.

2. The *Meridian* is that *Circle* which is exactly in *the middle* between the *East* and *West*, and always cuts the true *North* and *South* Points of the *Horizon*; its *Use* is to show the Times of *Mid-day* and *Mid-night*, for when the *Sun* comes to the *South Point* of *this Circle* which is *above* the *Horizon*, it is *Noon*, and when to that Point of the *Circle* which is *under* the *Horizon*, then it is *Midnight*, and *that Point* in the *Meridian* which is exactly *over your Head*, is called the *Zenith*, and that *under your Feet*, the *Nadir*.

The Equinoctial.

3. The *Equinoctial Circle* is always distant from you as much as is *the Latitude* of *the Place* you are in, and is also *equal* to the *Height* of the *Pole* above your *Horizon*; its *Use* is to determine the Time of the *Day* or *Night*; for every 15 *Deg.* thereof is *equal* to *one Hour* in *Time*, and it always cuts the true *East* and *West* Points of the *Horizon*.

The Ecliptick.

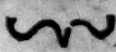
4. The *Ecliptick* is that *Circle* in which the *Sun* is said to move, and *this Circle* cuts the *Equinoctial* in the *beginning* of *Aries* and *Libra*, making an *Angle* therewith of 23 *Deg.* 29 *Min.* which *Angle* is equal to the *Sun's greatest Declination*: It is divided into *twelve* equal *Parts*, called *Signs*, and *charactered* as in the *Figure* with $\gamma, \vartheta, \pi, \&c.$ and

A Description of the Sphere.

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and every *Sign* is divided into *thirty* equal Parts called *Degrees*; so that

CHAP.
XXII.

This, and every great Circle of the Sphere contains 360 *Deg.* 

N. B. In or near this Circle the *Eclipse* of the *Sun* and *Moon* are always found from whence it takes its Name.

5. The *Equinoctial Colure* is a Circle that cuts the *Equinoctial* at *right Angles* in the beginning of *Aries* and *Libra*, and passes thro' the *Poles* of the World: This Circle determines the beginning of the *Spring*, and fall of the *Leaf*, for when the *Sun* comes here (which is on the 10th of *March* and 12th of *September*) the *Days* and *Nights* are equal.

The Equi-
noctial
Colure.

6. The *Solstitial Colure* is a Circle that cuts the *Equinoctial Colure* at *right Angles* in the *Poles* of the World, and when *Cancer* is upon the *Meridian*, this Circle is also upon the *Meridian* (as you may see by the Sphere) when the *Sun* comes to this *Colure* (which is upon the 10th of *June* and the 10th of *December*) he determines the longest and shortest *Days* to all the *Inhabitants* on the *North Side* the *Equinoctial*.

The Sol-
stitial Co-
lure.

N. B. The above six Circles cut the *World* into two equal Parts.

Secondly,

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XXII. Secondly, *Of the FOUR lesser Circles of the Sphere.*

*Of the
Four lesser
Circles.*

*The Tropick of
Cancer.*

1. The *Tropick of Cancer* is parallel to the *Equinoctial*, and distant from it 23 Deg. 29 Min. which is the *Sun's greatest Declination Northward*; here the *Ecliptick* and the *Solstitial Colure* meet in the very beginning of *Cancer*, making the *longest Day* to all the *Northern Inhabitants*.

*The Tropick of
Capricorn.*

2. The *Tropick of Capricorn* is also parallel to the *Equinoctial*, but distant from it 23 Deg. 29 Min. towards the *South*, and is equal to the *Sun's greatest Declination*; here the *Ecliptick* and *Solstitial Colure* meet in the very beginning of the Sign *Capricorn*, making the *shortest Day* to all the *Northern Inhabitants*.

The Reason why these are called *lesser Circles* is, because they cut the *Sphere* (or *World*) into *two unequal Parts*.

*The two
Polar Circles.*

LASTLY. The *two Polar Circles* are the same Distance from the *Poles*, that the *Tropicks* are from the *Equinoctial*, viz. 23 Deg. 29 Min. When the *Sun* enters *Cancer*, those that live under the *Arctic Circle* see him in their *Horizon* at *Midnight*, and when the *Sun* enters *Capricorn*, those that live under the *Antarctic Circle* see the *Sun* in their *Horizon* at *Midnight*.

The

A Description of the Sphere.

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The *Earth's Axis* is a Line supposed to pass from *Pole to Pole*, and through the *Earth's Center*; and note, it always represents the *Top*, or uppermost Part of the *Style* in all *Dials*: and makes an Angle with the *Horizon* equal to the *Latitude* of your Habitation: and it always cuts the *Equinoctial* at right Angles, and the *Equinoctial* makes an Angle with the *Horizon* equal to the Complement of the *Latitude* of the Place where you live.

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XXII.

The Earth's
Axis.

The *Earth* is fixed upon its *Axis* in the middle of the *Sphere* (or *World*) and in *Dialling* it is reckoned no more than a *Point*, because it is at so vast a Distance from the *Sun*.

The Earth.

N. B. The *Axis* of the *Ecliptick* is noted in the *Sphere*, but it is of no manner of Use in *Dialling*.

The Axis
of the
Ecliptick.



K

CHAP.

C H A P. XXIII.

Motto's for Dials, with their Meaning in English.

- 1 { **A** LIIS inferviendo confumor.
My Loss is your Gain.
- 2 { Ars longa Vita brevis.
I die to-day and live to-morrow.
- 3 { Avaritia Hodie dominatur.
You covet to-morrow.
- 4 { Aut Cæsar aut Nihil.
I shine or shroud.
- 5 See, and be gone about your Business.
- 6 { Bulla est Vita humana.
Life's a Bubble.
- 7 Consume not thy Time in Idleness.
- 8 { Deus adest laborantibus.
Heaven favours the diligent.
- 9 { Disce dies numerare tuos.
Learn to value your Time.
- 10 { Disce bene vivere & mori.
Shine and Set.
- 11 { Dies diem trudit.
A Day kicks me down.
- 12 { Dum spectas fugio.
Unfight, unseen.

Motto's for Dials, &c.

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XXIII

- 13 { * En supra Vita fugax,
† En infra certa Mors.
A Life on flight's soon out of sight.
- 14 { Ex hoc Momento pendet Æternitas.
Now or never.
- 15 { Festina Lente.
Mind my Movements.
- 16 { Fortuna urbes ampliffimas evertit.
No Exemption from my Influence.
- 17 { Fugio Fuge.
Be gone about your Business.
I stay for no Man.
- 18 { * Hinc vivere disce,
† Illinc disce Mori.
Rising portends Setting.
- 19 { Homo quasi Umbra.
Man is Shade of a Shadow.
- 20 { Hora fugit rapide lethumq; invadit inermes;
The Hours glide swiftly, and the unguarded are easily surprized.
- 21 { Hora pars Vitæ.
Every Hour shortens Life.
- 22 { Ita Vita.
Such is Life's half Circle.
- 23 { Labor ipse voluptas.
My Pain is your Pleasure.
- 24 { Lex Dei Lux Diei.
The Law of God is broad Day-light.

* At the Top { of one Face of a Dial on St Mary Overy's
† At the Bottom { Church, Southwark, which hangs over the
Burial Ground.

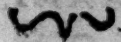
* At the Top { of another Face of the Dial on St Mary
† At the Bottom { Overy's Church, Southwark, which hangs
over the Burial Ground.

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XXIII

- 25 † *Let your Light so shine that Men may see your good Works.*
- 26 { *Lente suscipe cito perfice.*
Set out at Leisure, proceed with haste.
- 27 { *Mora trahit periculum.*
Delay drags Danger.
- 28 { *Nemo sine crimine vivit.*
The brightest Day has its shades.
- 29 { *Nil dat quod non habet.*
Out of nothing comes nothing.
- 30 { *Non semper erunt Saturnalia.*
Take Time by the Forelock.
- 31 { *Non nobis nati sumus.*
We are not made for our selves.
- 32 { *Non sine lumine.*
We shine.
- 33 { *Nosce teipsum.*
Look into thy self.
- 34 { *Nulla dies sine linea.*
Every Day has its bounds.
- 35 { *Omnem crede diem tibi diluxisse supremum.*
Believe every Day to be thy last.
- 36 { *Omnia falce metit tempus.*
The scythe of Time carries a keen Edge.
- 37 { *Pereunt & imputantur.*
The Hours vanish, yet are on Record.
- 38 { *Pax optima rerum.*
Light is the Parent of Peace.
- 39 { *Post voluptatem misericordia.*
** Pleasure is the Parent of Pain.*
Night treads upon the Heels of Day.

† In Lincoln's Inn, London.

* Upon a Dial at a Lock, or Hospital for those who have the soul Disease.

- 40 { Qualis vita, finis ita.
Praise a fair Day at Night.
- 41 { Quod tibi fieri non vis, alteri ne feceris. 
Do not render Evil for Good.
- 42 { Qua redit nescitis horam.
Ye know not the Hour.
- 43 { Quid celerius tempore?
What is swifter than Time?
- 44 { Sic vita.
Life's Lot.
- 45 { Sic transit gloria mundi.
So marches the god of Day.
- 46 { Sine lumine inane.
Darkness precedes Day.
- 47 { Sic præterit Ætas.
Life is winged.
- 48 { Tempus ad lucem ducit veritatem.
Time brings Truth to Light.
- 49 { Tempus obit, mors venit.
Time dies, Death reigns.
- 50 { Tempus fugit.
Time hastes.
- 51 { Tempus vitæ monitor.
Time is Life's Remembrancer.
- 52 { Tenere non potes nec perdere.
You cannot keep it, nor lose it.
- 53 { Umbra Dei.
The Workmanship of the great Architect.
- 54 { Ut umbra sic vita.
Shade is Life's Pattern.
- 55 { Venio ut fur.
I steal upon you.

- 56 { Vigilate & orate, tempus fugit.
Watch and Pray, Time hastes away.
 Via vitæ.
 57 { *Life's Road.*
 58 { Vita nostra est instar Comœdiæ,
Life often changes Scenes.
 59 { Veritas temporis filia.
Time the Father of Truth.
 60 * Welcome Chapmen.

* On a Dial in a Market-place.

C H A P. XXIV.

A new Table of the Elevation of the Pole, and Difference of Meridians from London.

A *New and Correct Alphabetical Table of the most eminent Cities, Towns, &c. in the World; * shewing at each Place the Elevation of the Pole, and the Difference of their Meridian from London.*

* N. B. The Table of the principal Cities and Towns in *England, Scotland, Ireland and Wales* is on Page (16, &c.)

☞ The

☞ The *Elevation of the Pole* signifies the CHAP. same Thing as the *Latitude of the Place*, XXIV. and the *Difference of the Meridian*, the same as the *Longitude of the Place*.

Note,

| | | | | | | | |
|---|---------------|---------|-------|---|---------------|-------|--------------|
| D | } signifies { | Degrees | | E | } signifies { | East | } Longitude. |
| H | | Hours | | W | | West | |
| M | | Minutes | | N | | North | |
| | | S | South | | | | |

An Explanation of the following Table.

The *Names* of the *Places* stand in an *Alphabetical Order*, and those *Names* are always followed by *One* or *Two* more in the same *Line* or *Article*. Where there is but *One* *Name* following *that* of the *Place*, it signifies what *Kingdom* or *Part of the World* it is situated in; as *Athens*, *Greece*, signifies that *Athens* is in *Greece*: But where there are *Two* *Names* following the *Name* of the *Place*, the *First* signifies the *Province* or *Division*, and the *Second* the *Kingdom* or *Part of the World*, as *Abbeville*, *Picardy*, *France*, signifies that *Abbeville* is in *Picardy*, which is a *Province* in *France*, and so of all the rest.

K 4

A. *Abbeville*,

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| A. | Latit. | | Dif. Mer. | |
|---|--------|------|-----------|------|
| | D. | M | H. | M |
| <i>Abbeville</i> , Picardy,
France | 50 | 9 N | 0 | 9 E |
| <i>Abo</i> , Finland, Sweden | 60 | 20 N | 1 | 39 E |
| <i>Achin</i> , Sumatra, East-
Indies | 4 | 40 N | 6 | 13 E |
| <i>Acquin</i> , Montferrat, Italy | 44 | 13 N | 0 | 41 E |
| <i>Adrianople</i> , Turkey, Eu-
rope | 43 | 18 N | 1 | 50 E |
| <i>Agen</i> , Guienne, France | 44 | 13 N | 0 | 2 E |
| <i>Agra</i> , a Capital in the
Mogul's Empire | 29 | 0 N | 5 | 38 E |
| <i>Agria</i> , Hungary | 48 | 2 N | 1 | 12 E |
| <i>Aichstat</i> , Franconia, Ger-
many | 48 | 46 N | 0 | 43 E |
| <i>Aix</i> , Provence, France | 43 | 4 N | 0 | 23 E |
| <i>Aix la Chapelle</i> , West-
phalia, Germany | 50 | 48 N | 0 | 28 E |
| <i>Albert</i> , Gascony, France | 44 | 14 N | 0 | 4 W |
| <i>Alby</i> , Languedoc, France | 43 | 43 N | 0 | 8 E |
| <i>Alba Regalis</i> , Hungary | 47 | 23 N | 1 | 8 E |
| <i>Alcala</i> , New Castile, Spain | 40 | 30 N | 0 | 13 E |
| <i>Alcantara</i> , Extremadura,
Spain | 9 | 15 N | 0 | 23 W |
| <i>Alegran</i> , New Castile,
Spain | 39 | 0 N | 0 | 7 W |
| <i>Alençon</i> , Normandy,
France | 48 | 31 N | 0 | 1 E |
| <i>Aleppo</i> , Syria, Asia | 37 | 0 N | 2 | 45 E |
| <i>Alexandria</i> , Egypt, Africa | 31 | 25 N | 2 | 3 E |
| <i>Alexandretta</i> , Syria, Asia | 37 | 10 N | 2 | 31 E |

Algiers,

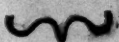
Pole, and Difference of Meridians. 137

| | Latit. | | Dif. Mer. | | CHAP. |
|--------------------------------------|--------|------|-----------|------|----------------|
| | D. | M. | H. | M. | XXIV |
| <i>Algiers</i> , Barbary, Africa | 36 | 20 N | 0 | 9 E | W |
| <i>Alicant</i> , Valentia, Spain | 37 | 45 N | 0 | 1 E | |
| <i>Almeria</i> , Granada, Spain | 35 | 50 N | 0 | 8 W | |
| <i>Amand</i> , Bourbon, France | 46 | 32 N | 0 | 9 E | |
| <i>Amberg</i> , Bavaria, Germany | 49 | 26 N | 0 | 52 E | |
| <i>Ambrun</i> , see Embrun | | | | | |
| <i>Amiens</i> , Picardy, France | 49 | 30 N | 0 | 11 E | |
| <i>Amsterdam</i> , Holland | 52 | 29 N | 0 | 20 E | |
| <i>Ancona</i> , Italy | 43 | 30 N | 0 | 58 E | |
| <i>Angers</i> , Orleans, France | 47 | 27 N | 0 | 4 E | |
| <i>Angoulesme</i> , Orleans, France | 45 | 25 N | 0 | 2 W | |
| <i>Angiera</i> , Milan, Italy | 45 | 8 N | 0 | 39 E | |
| <i>Annacy</i> , Savoy, Italy | 45 | 56 N | 0 | 27 E | |
| <i>Antibe</i> , Provence, France | 43 | 15 N | 0 | 33 E | |
| <i>Antwerp</i> , Brabant | 51 | 16 N | 0 | 17 E | |
| <i>Antequera</i> , Granada, Spain | 36 | 40 N | 0 | 16 W | |
| <i>Aouste</i> , Piedmont, Italy | 45 | 40 N | 0 | 30 E | |
| <i>Apenzel</i> , Switzerland | 46 | 57 N | 0 | 43 E | |
| <i>Appenrade</i> , Sleswick, Denmark | 55 | 26 N | 0 | 42 E | |
| <i>Apte</i> , Provence, France | 43 | 50 N | 0 | 24 E | |
| <i>Aquila</i> , Naples, Italy | 42 | 18 N | 0 | 58 E | |
| <i>Aranda</i> , Old Castile, Spain | 41 | 20 N | 0 | 12 W | |
| <i>Archangel</i> , Russia, | 64 | 30 N | 2 | 41 E | |
| <i>Ardres</i> , Picardy, France | 50 | 53 N | 0 | 7 E | |
| <i>Arbusen</i> , Jutland, Denmark | 56 | 32 N | 0 | 45 E | |
| | | | | | <i>Arica</i> , |

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| CHAP.
XXIV | | Latit. | | Dif. Mer. | |
|---------------|--|--------|------|-----------|------|
| | | D. M | | H. M | |
| | <i>Arica</i> , Peru, South Ame-
rica | 18 | 50 S | 4 | 59 W |
| | <i>Arles</i> , Provence, France | 43 | 15 N | 0 | 19 E |
| | <i>Armentiers</i> , Flanders | 50 | 45 N | 0 | 8 E |
| | <i>Asperosa</i> , Romania, Tur-
key | 40 | 50 N | 1 | 43 E |
| | <i>Astracan</i> , near the Caspi-
an Sea, Muscovy | 46 | 50 N | 3 | 26 E |
| | <i>Asti</i> , Piedmont, Italy | 44 | 40 N | 0 | 34 E |
| | <i>Astorgos</i> , Leon, Spain | 42 | 29 N | 0 | 22 E |
| | <i>Athens</i> , Greece | 37 | 25 N | 1 | 35 E |
| | <i>Avignon</i> , Provence,
France | 43 | 15 N | 0 | 19 E |
| | <i>Ausburg</i> , Suabia, Ger-
many | 47 | 55 N | 0 | 43 E |
| | <i>Autun</i> , Burgundy, France | 46 | 38 N | 0 | 18 E |
| | <i>Aux</i> , Gascony, France | 43 | 50 N | 0 | 5 E |
| | <i>Axiopoli</i> , Bulgaria, Tur-
key | 44 | 30 N | 1 | 42 E |
| | B. | | | | |
| | <i>Babylon</i> , Chaldea | 34 | 30 N | 3 | 14 E |
| | <i>Badajox</i> , Extremadura,
Spain | 38 | 40 N | 0 | 24 E |
| | <i>Baden</i> , Suabia, Germany | 48 | 38 N | 0 | 32 E |
| | <i>Bagdat</i> , Mesopotamia,
Asia | 33 | 0 N | 3 | 2 E |
| | <i>Bagnialuc</i> , Bosnia, Tur-
key | 44 | 25 N | 1 | 2 E |
| | <i>Babus</i> , Norway | 58 | 14 N | 0 | 52 E |

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| | Latit. | Dif. Mer. | CHAP. |
|--|---------|-----------|--|
| | D. M | H. M | XXIV. |
| <i>Balaguer</i> , Catalonia,
Spain | 41 30 N | 0 1 E |  |
| <i>Balbastro</i> , Arragon,
Spain | 41 46 N | 0 1 W | |
| <i>Baldivia</i> , Chili, South-
America | 40 0 S | 5 12 W | |
| <i>Bamburg</i> , Franconia,
Germany | 49 35 N | 0 45 E | |
| <i>Barbadoes</i> , West-Indies | 13 10 N | 3 59 W | |
| <i>Barcelona</i> , Catalonia,
Spain | 41 10 N | 0 8 E | |
| <i>Barn</i> , Naples, Italy | 41 7 N | 1 10 E | |
| <i>Barletta</i> , Naples, Italy | 41 20 N | 1 8 E | |
| <i>Barleduc</i> , Champagne,
France | 48 44 N | 0 16 E | |
| <i>Basil</i> , Switzerland | 47 34 N | 0 32 E | |
| <i>Batavia</i> , Java, East-
Indies | 6 05 S | 7 6 E | |
| <i>Bayonne</i> , Gascony,
France | 43 30 N | 0 5 W | |
| <i>Beauvoies</i> , France | 49 20 N | 0 6 E | |
| <i>Beaufort</i> , Anjou, France | 47 20 N | 0 3 E | |
| <i>Beaujeau</i> , Lionois,
France | 45 50 N | 0 18 E | |
| <i>Belgrade</i> , Servia | 45 0 N | 1 13 E | |
| <i>Belvedere</i> , Naples, Italy | 39 35 N | 1 6 E | |
| <i>Benevente</i> , Spain | 41 55 N | 0 21 W | |
| <i>Beneventum</i> , Naples,
Italy | 41 13 N | 1 2 E | |
| <i>Bengal</i> , India | 21 0 N | 5 12 E | |
| <i>Bergamo</i> , | | | |

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XXIV.

| | Latit. | | Dif. Mer. | |
|---|--------|------|-----------|------|
| | D. | M | H. M | |
| <i>Bergamo, Italy</i> | 45 | 48 N | 0 | 39 E |
| <i>Bergen, Norway</i> | 60 | 0 N | 0 | 22 E |
| <i>Berlin, Upper Saxony,</i>
Germany | 52 | 10 N | 0 | 52 E |
| <i>Bern, Switzerland,</i> | 47 | 0 N | 0 | 31 E |
| <i>Besancon, Burgundy,</i>
France | 47 | 10 N | 0 | 25 E |
| <i>Bielsk, Poland</i> | 52 | 50 N | 1 | 37 E |
| <i>Bielba, Russia</i> | 55 | 36 N | 2 | 13 E |
| <i>Bilboa, Biscay, Spain</i> | 43 | 10 N | 0 | 9 E |
| <i>Bilogrod, Budziack,</i>
Turkey | 47 | 15 N | 2 | 1 E |
| <i>Biorneburgh, Finland,</i>
Sweden | 62 | 12 N | 1 | 30 E |
| <i>Blois, Orleanois, France</i> | 47 | 30 N | 0 | 5 E |
| <i>Bologna or Boulogne,</i>
Italy | 44 | 20 N | 0 | 48 E |
| <i>Bologne, Picardy, France</i> | 50 | 36 N | 0 | 7 E |
| <i>Bonn, Lower Rhine,</i>
Germany | 50 | 30 N | 0 | 30 E |
| <i>Borkholm, Oeland, Swe-</i>
den | 57 | 10 N | 1 | 15 E |
| <i>Bosleduc, Brabant, Flan-</i>
ders | 51 | 30 N | 0 | 20 E |
| <i>Boston, New-England</i> | 42 | 10 N | 4 | 28 W |
| <i>Bourdeaux, Guienne,</i>
France | 44 | 55 N | 0 | 3 E |
| <i>Boulogne, Modena, Italy</i> | 44 | 15 N | 0 | 48 E |
| <i>Bourges, Orleanois,</i>
France | 46 | 54 N | 0 | 10 E |
| <i>Braga,</i> | | | | |

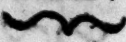
Pole, and Difference of Meridians. 141

| | Latit. | | Dif. Mer. | | CHAP. |
|---|--------|------|-----------|------|-------|
| | D. | M | H. M | | XXIV |
| <i>Braga</i> , Portugal | 41 | 30 N | 0 | 31 W | ~ |
| <i>Brandenburgh</i> , Upper Saxony, Germany | 52 | 10 N | 0 | 50 E | |
| <i>Brest</i> , Bretagne, France | 48 | 34 N | 0 | 18 E | |
| <i>Breda</i> , Spanish Provinces | 51 | 30 N | 0 | 17 E | |
| <i>Bremen</i> , Westphalia, Germany | 53 | 0 N | 0 | 35 E | |
| <i>Brescia</i> , Venice, Italy | 45 | 36 N | 0 | 42 E | |
| <i>Brieux</i> , Bretagne, France | 48 | 30 N | 0 | 10 E | |
| <i>Breshaw</i> , Bohemia, Germany | 51 | 5 N | 1 | 6 E | |
| <i>Briancon</i> , Dauphine, France | 44 | 50 N | 0 | 25 E | |
| <i>Brill</i> , Holland | 51 | 55 N | 0 | 25 E | |
| <i>Brindisi</i> , Naples, Italy | 40 | 48 N | 1 | 13 E | |
| <i>Brixen</i> , Austria, Germany | 46 | 29 N | 0 | 47 E | |
| <i>Brunswick</i> , Germany | 51 | 55 N | 0 | 46 E | |
| <i>Brugencia</i> , Genoa, Italy | 44 | 28 N | 0 | 40 E | |
| <i>Bruges</i> , Flanders | 51 | 15 N | 0 | 12 E | |
| <i>Brussels</i> , Flanders | 50 | 48 N | 0 | 16 E | |
| <i>Buda</i> , Lower Hungary | 47 | 0 N | 1 | 8 E | |
| <i>Budissen</i> , Lusatia, Germany | 50 | 50 N | 0 | 59 E | |
| C. | | | | | |
| <i>Cadiz</i> , Andalusia, Spain | 36 | 5 N | 0 | 23 W | |

Caen,

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XXIV

| | Latit.
D. M | Dif. Mer.
H. M |
|---|----------------|-------------------|
|  <i>Caen</i> , Normandy,
France | 49 5 N | 0 22 W |
| <i>Cagliari</i> , Sardinia, Me-
diterranean | 39 10 N | 0 38 E |
| <i>Cabors</i> , Guienne, France | 44 26 N | 0 6 E |
| <i>Cairo</i> , Egypt, Africa | 30 10 N | 2 6 E |
| <i>Calais</i> , France | 51 0 N | 0 8 E |
| <i>Calmar</i> , Sweden | 56 55 N | 1 9 E |
| <i>Calaborra</i> , Old Castile,
Spain | 41 52 N | 0 8 W |
| <i>Calecute</i> , East-Indies | 11 0 N | 4 59 E |
| <i>Cambray</i> , France | 50 10 N | 0 13 E |
| <i>Camin</i> , Pomerania,
Germany | 53 54 N | 1 1 E |
| <i>Candia</i> , in Candia-Island | 34 55 N | 1 39 E |
| <i>Candia</i> , Ceylon, East-
Indies | 7 30 N | 5 22 E |
| <i>Cape of Good Hope</i> | 34 25 S | 1 6 E |
| <i>Capra</i> , Naples, Italy | 41 8 N | 1 1 E |
| <i>Cartagena</i> , Murcia,
Spain | 37 0 N | 0 2 E |
| <i>Carthage</i> , Barbary,
Africa | 35 0 N | 0 44 E |
| <i>Casal</i> , Milan, Italy | 45 5 N | 0 34 E |
| <i>Castillon</i> , Guienne,
France | 44 32 N | 0 7 E |
| <i>Cascharo</i> , Hungary | 48 30 N | 1 13 E |
| <i>Catanea</i> , Sicily | 37 20 N | 1 1 E |
| <i>Cattaro</i> , Dalmatia | 41 50 N | 1 10 E |

Caudebeck,

Pole, and Difference of Meridians. 143

| | Latit. | Dif. Mer. | CHAP. |
|--|---------|-----------|-------|
| | D. M | H. M | XXIV |
| <i>Caudebeck</i> , Normandy,
France | 49 36 N | 0 2 E | |
| <i>Ceva</i> , Piedmont, Italy | 43 56 N | 0 51 E | |
| <i>Ceuta</i> , Africa | 35 50 N | 0 23 W | |
| <i>Charles Town</i> in Caro-
lina | 32 30 N | 5 24 W | |
| <i>Chalons</i> , Champagne,
France | 48 50 N | 0 19 E | |
| <i>Chambery</i> , Savoy, Italy | 45 38 N | 0 24 E | |
| <i>Chimera</i> , Epirus, Tur-
key | 39 25 N | 1 12 E | |
| <i>Christianstad</i> , Gothland,
Sweden | 56 35 N | 0 58 E | |
| <i>Clausenburgh</i> , Transyl-
vania | 47 20 N | 1 24 E | |
| <i>Clermont</i> , Lionois,
France | 45 40 N | 0 13 E | |
| <i>Cleves</i> , Westphalia,
Germany | 51 40 N | 0 25 E | |
| <i>Coblentz</i> , Lower Rhine,
Germany | 50 0 N | 0 10 E | |
| <i>Cochin</i> , Malabar, Asia | 10 0 N | 5 1 E | |
| <i>Cochin China</i> , E. Indies,
Asia | 13 0 N | 7 8 E | |
| <i>Coimbra</i> , Biera, Portu-
gal | 39 50 N | 0 31 W | |
| <i>Cologne</i> , Germany | 50 40 N | 0 29 E | |
| <i>Compostella</i> , Galicia,
Spain | 42 45 N | 0 33 W | |

Constance,

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| | Latit. | | Dif. Mer. | |
|--|--------|------|-----------|--------------|
| | D. | M | H. | M |
| <i>Constance</i> , Suabia, Germ. | 47 | 20 N | 0 | 39 E |
| <i>Constantinople</i> , Romania, Turkey | 41 | 6 N | 1 | 59 E |
| <i>Conza</i> , Naples, Italy | 40 | 45 N | 1 | 4 E |
| <i>Contessa</i> , Macedon. Tur. | 40 | 55 N | 1 | 38 E |
| <i>Copenhagen</i> , Zeland, Denmark | 55 | 40 N | 0 | 50 E |
| <i>Coria</i> , Extremadura, Sp. | 39 | 20 N | 0 | 22 W |
| <i>Corinth</i> , Morea, Turkey | 38 | 0 N | 1 | 30 E |
| <i>Cosmopoli</i> , on the Island Elba, Italy | 42 | 30 N | 0 | 44 E |
| <i>Cosenza</i> , Naples, Italy | 39 | 15 N | 1 | 7 E |
| <i>Cossana</i> , Naples, Italy | 40 | 12 N | 1 | 8 E |
| <i>Coutance</i> , Normand. Fr. | 49 | 10 N | 0 | 7 W |
| <i>Cracow</i> , Poland | 50 | 15 N | 1 | 23 E |
| <i>Cremona</i> , Milan, Italy | 45 | 10 N | 0 | 42 E |
| <i>Cusco</i> , Peru, S. America | 12 | 20 S | 4 | 48 W |
| <i>Cyprus-Island</i> , Levant | 35 | 0 N | 2 | 16 E |
| D. | | | | |
| <i>Dantzick</i> , Poland | 54 | 25 N | 1 | 18 E |
| <i>Dardanells</i> , Turkey | 40 | 0 N | 1 | 52 E |
| <i>Darmstat</i> , Upper Rhine, Germany | 49 | 30 N | 0 | 37 E |
| <i>Delft</i> , Holland | 52 | 10 N | 0 | 17 E |
| <i>Derbent</i> , near the Caspian Sea | 42 | 0 N | 3 | 20 E |
| <i>Deventer</i> , United Prov. | 51 | 56 N | 0 | 24 E |
| <i>Deux Ponts</i> , Upper Rh. Germany | 49 | 10 N | 0 | 29 E |
| <i>Die</i> , Dauphine, France | 44 | 45 N | 0 | 22 E |
| | | | | <i>Dijon</i> |

Pole, and Difference of Meridians. 145

| | Latit. | | Dif. Mer. | | CHAP. |
|----------------------------------|--------|------|-----------|---------|--|
| | D. | M | H.M | | XXIV. |
| <i>Dijon</i> , Bourgogne, Fr. | 47 | 15 N | 0 20 E | |  |
| <i>Dole</i> , Bourgogne, Fran. | 46 | 50 N | 0 23 E | | |
| <i>Dort</i> , Low-Countries, | | | | | |
| Holland | 51 | 45 N | 0 18 E | | |
| <i>Doway</i> , Flanders | 50 | 12 N | 0 14 E | | |
| <i>Dresden</i> , Saxony, Germ. | 51 | 6 N | 0 55 E | | |
| <i>Drontheim</i> , Norway | 63 | 0 N | 0 41 E | | |
| <i>Dunkirk</i> , France | 51 | 7 N | 0 10 E | | |
| <i>Durazzo</i> , Albania, Tur. | 40 | 40 N | 1 11 E | | |
| <i>Dusseldorp</i> , Westph. Ger. | 51 | 0 N | 0 28 E | | |
| E. | | | | | |
| <i>Elbing</i> , Poland | 54 | 20 N | 1 22 E | | |
| <i>Ellenera</i> , Extremad. Sp. | 37 | 45 N | 0 19 W | | |
| <i>Elsinborg</i> , Schonen, Sw. | 56 | 0 N | 0 53 E | | |
| <i>Emden</i> , Westph. Germ. | 53 | 10 N | 0 29 E | | |
| <i>Embrun</i> , Upper Dau- | | | | | |
| phine, France | 44 | 30 N | 0 25 E | | |
| <i>Enchuyfen</i> , Holland | 52 | 50 N | 0 18 E | | |
| <i>Ephesus</i> , Natolia, Asia | 37 | 50 N | 1 50 E | | |
| <i>Erfort</i> , Saxony, Germ. | 50 | 40 N | 0 46 E | | |
| <i>Essék</i> , Sclavonia | 45 | 35 N | 1 9 E | | |
| <i>Estella</i> , Navarre, Spain | 42 | 15 N | 0 7 W | | |
| <i>Eoora</i> , Portugal | 38 | 10 N | 0 29 W | | |
| <i>Eureux</i> , Normandy, Fr. | 48 | 55 N | 0 3 W | | |
| <i>Eysenach</i> , Saxony, Germ. | 50 | 40 N | 0 43 E | | |
| F. | | | | | |
| <i>Ferrara</i> , Italy | 44 | 45 N | 0 49 E | | |
| <i>Feurs</i> , Lionois, France | 45 | 24 N | 0 15 E | | |
| <i>Fermo</i> , Tuscany, Italy | 43 | 10 N | 0 59 E | | |
| <i>Fez</i> , Barbary, Africa | 33 | 15 N | 0 24 W | | |
| L | | | | | |
| | | | | Finale, | |

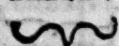
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CHAP.
XXIV.

| | Latit. | Dif. Mer. |
|--|---------|-----------|
| | D. M | H. M |
| <i>Finale, Genoa, Italy</i> | 44 10 N | 0 34 E |
| <i>Florence, Tuscany, Italy</i> | 43 40 N | 0 47 E |
| <i>St Flour or Flerus, Lio-</i>
<i>nois, France</i> | 44 50 N | 0 13 E |
| <i>Fort St George, East</i>
<i>Indies</i> | 13 0 N | 5 20 E |
| <i>Fontarabia, Biscay,</i>
<i>Spain</i> | 43 0 N | 0 7 W |
| <i>Frankfort on the Oder,</i>
<i>Germany</i> | 52 28 N | 0 58 E |
| <i>Frankfort on the Main,</i>
<i>Germany</i> | 49 45 N | 0 39 E |
| <i>Freisingen, Bavaria,</i>
<i>Germany</i> | 48 0 N | 0 47 E |
| <i>Freiburg, Suabia, Germ.</i> | 47 50 N | 0 33 E |
| <i>Frejuls, Provence, Fran.</i> | 43 30 N | 0 28 E |
| <i>Furness, Flanders</i> | 51 15 N | 0 11 E |
| <i>Furstenburg, Suabia,</i>
<i>Germany</i> | 47 15 N | 0 37 E |
| <i>G.</i> | | |
| <i>Gallipoli, Romania,</i>
<i>Turkey</i> | 40 55 N | 1 53 E |
| <i>Gelders, Gelderland</i> | 51 15 N | 0 26 E |
| <i>Geneva, Savoy, Italy</i> | 46 15 N | 0 25 E |
| <i>Genoa, Italy</i> | 44 25 N | 0 37 E |
| <i>Ghent, Flanders</i> | 51 6 N | 0 14 E |
| <i>Gibraltar, Andaluzia,</i>
<i>Spain</i> | 35 30 N | 0 19 E |
| <i>Girona, Catalonia, Spain</i> | 41 45 N | 0 13 E |

Pole, and Difference of Meridians. 147

| | Latit. | Dif. Mer. | CHAP. |
|------------------------------------|---------|-----------|-------|
| | D. M | H. M | XXIV. |
| <i>Gisors</i> , Normandy, | | | |
| France | 49 20 N | 0 8 E | |
| <i>Glatz</i> , Bohemia, Germ. | 50 30 N | 1 7 E | |
| <i>Gnesna</i> , Poland | 52 25 N | 1 14 E | |
| <i>Goa</i> , East Indies | 15 22 N | 4 58 E | |
| <i>Gombroon</i> , Persian Gulf | 7 10 N | 3 44 E | |
| <i>Gottenburgh</i> , Sweden | 57 30 N | 0 48 E | |
| <i>Gran</i> , Hungary | 47 30 N | 1 6 E | |
| <i>Granada</i> , Granada, | | | |
| Spain | 36 20 N | 0 11 E | |
| <i>Gratz</i> , Austria, Germ. | 47 10 N | 1 6 E | |
| <i>Graveling</i> , Flanders | 51 4 N | 0 10 E | |
| <i>Grenoble</i> , Dauphine, | | | |
| France | 45 10 N | 0 23 E | |
| <i>Grodno</i> , Lithuania, | | | |
| Poland | 53 25 N | 1 40 E | |
| <i>Groeningen</i> , Holland | 53 5 N | 0 23 E | |
| <i>Guadix</i> , or <i>Gaudix</i> , | | | |
| Granada, Spain | 36 40 N | 0 9 E | |
| <i>Guadalaxara</i> , New Ca- | | | |
| stle, Spain | 40 25 N | 0 11 E | |
| <i>Gyulla</i> , Hungary | 46 30 N | 1 16 E | |
| H. | | | |
| <i>Hague</i> , Holland | 52 10 N | 0 16 E | |
| <i>Hall</i> , Suabia, Germany | 49 6 N | 0 41 E | |
| <i>Hamburgh</i> , Denmark | 53 30 N | 0 40 E | |
| <i>Hanaw</i> , Upper Rhine, | | | |
| Germany | 50 3 N | 0 41 E | |
| <i>Hanover</i> , Saxony, Germ. | 52 16 N | 0 36 E | |
| <i>Harlem</i> , Holland | 52 25 N | 0 17 E | |



Heidelberg, Lower Rh.

Germany

Latit.
D. MDif. Mer.
H. M

49 12 N 0 35 E

Helmstat, Saxony Germ.

51 52 N 0 49 E

Hermanstat, Transyl-
vania

46 45 N 1 28 E

Hildesheim, Westphalia,

Germany

51 45 N 0 41 E

Hoen-Zolern, Suabia,

Germany

48 40 N 0 37 E

Huesca, Saragosa, Spain

41 45 N 0 1 W

Hulst, Flanders

51 20 N 0 19 E

I.

Jaca, Arragon, Spain

37 20 N 0 2 W

Jaen, Granada, Spain

37 0 N 0 11 W

Jaicza, Bosnia, Turkey

44 40 N 1 2 E

James Town, Virginia,

North America

37 10 N 5 0 W

Jerusalem, Palestine,

Asia

32 44 N 2 21 E

Ingolstat, Bavaria, Germ.

48 32 N 0 52 E

Inspruck, Austria, Germ.

47 40 N 0 59 E

Ispahan, Antient Par-
thia, Persia

33 0 N 3 33 E

Juanagorod, Ingria,

Muscovy

59 0 N 1 57 E

Judenburgh, Austria,

Germany

47 20 N 1 1 E

Juliers, Westphalia,

Germany

50 20 N 0 27 E

Ivrea, Piedmont, Italy

46 0 N 0 30 E

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| | Latit. | Dif. Mer. | CHAP. |
|------------------------------------|---------|-----------|-------|
| | D. M | H.M | XXIV. |
| K. | | | |
| <i>Kaffa</i> , Crim Tartary, | | | |
| Turkey | 46 0 N | 2 27 E | |
| <i>Kaminaick</i> , Podolia, | | | |
| Poland | 49 20 N | 1 38 E | |
| <i>Kanifcha</i> , Hungary | 46 35 N | 1 0 E | |
| <i>Kargapol</i> , Russia | 61 30 N | 2 49 E | |
| <i>Kexholm</i> , Finland, Swed. | 61 20 N | 2 4 E | |
| <i>Kimi</i> , Lapland, Sweden | 65 45 N | 1 37 E | |
| <i>Kiow</i> , Ukrain, Poland | 50 30 N | 2 10 E | |
| <i>Koningſburgh</i> , Prussia, | | | |
| Poland | 54 55 N | 1 29 E | |
| <i>Konizeck</i> or <i>Konioz</i> , | | | |
| Poland | 54 15 N | 1 15 E | |
| L. | | | |
| <i>Langrez</i> , Champagne, | | | |
| France | 47 55 N | 0 22 E | |
| <i>Lanciano</i> , Naples, Italy | 41 50 N | 1 0 E | |
| <i>Lancicio</i> , Poland | 52 15 N | 1 19 E | |
| <i>Landspergh</i> , Poland | 52 55 N | 1 2 E | |
| <i>Landau</i> , Suabia, Germ. | 48 50 N | 0 33 E | |
| <i>Laodicea</i> , Natolia, Asia | 38 10 N | 1 58 E | |
| <i>Laon</i> , Lionoise, France | 49 30 N | 0 15 E | |
| <i>Lariſſa</i> , Theſſaly, Tur- | | | |
| key in Europe | 39 30 N | 1 29 E | |
| <i>Larta</i> , Epirus, Greece, | | | |
| now Turkey | 39 0 N | 1 17 E | |
| <i>Lauback</i> , Austria, Germ. | 46 25 N | 0 59 E | |
| <i>Lawenbergh</i> , Saxony, | | | |
| Germany | 53 20 N | 0 43 E | |
| L 3 | | | |
| Legorn | | | |

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CHAP.
XXIV.

| | <i>Latit.</i>
D. M | | <i>Dif. Mer.</i>
H. M | |
|---------------------------------|-----------------------|------|--------------------------|-----------------|
| <i>Legorn or Leghorn,</i> | | | | |
| <i>Tuscany, Italy</i> | 43 | 40 N | 0 | 45 E |
| <i>Lemburgh, Poland</i> | 49 | 50 N | 1 | 41 E |
| <i>Leon, Asturia, Spain</i> | 42 | 34 N | 0 | 20 W |
| <i>Leopoldstat, Hungary</i> | 48 | 45 N | 1 | 15 E |
| <i>Lepanto, Achaia, Turkey</i> | 38 | 30 N | 1 | 23 E |
| <i>Lerida, Catalonia, Spain</i> | 41 | 15 N | 0 | 3 E |
| <i>Lewardin, West Frief-</i> | | | | |
| <i>land, Holland</i> | 53 | 0 N | 0 | 26 E |
| <i>Leyden, Holland</i> | 52 | 10 N | 0 | 14 E |
| <i>Leypsick, Germany</i> | 50 | 50 N | 0 | 51 E |
| <i>Leige, Spanish Provinces</i> | 50 | 25 N | 0 | 22 E |
| <i>Lima, Peru, S. America</i> | 11 | 30 S | 5 | 15 W |
| <i>Limoges, Guienne, Fran.</i> | 45 | 40 N | 0 | 6 E |
| <i>Limburgh, Spain</i> | 50 | 20 N | 0 | 25 E |
| <i>Lingen, Westphalia,</i> | | | | |
| <i>Germany</i> | 52 | 25 N | 0 | 31 E |
| <i>Lintz, Austria, Germ.</i> | 48 | 10 N | 0 | 58 E |
| <i>Lip or Lippa, Transyl-</i> | | | | |
| <i>vania</i> | 45 | 50 N | 1 | 15 E |
| <i>Lisle, Flanders</i> | 50 | 40 N | 0 | 11 E |
| <i>Lisbon, Portugal</i> | 38 | 45 N | 0 | 33 W |
| <i>Livorn, see Leghorn</i> | | | | |
| <i>Lodi, Milan, Italy</i> | 45 | 20 N | 0 | 40 E |
| <i>Logronna, Old Castile,</i> | | | | |
| <i>Spain</i> | 42 | 10 N | 0 | 9 E |
| <i>Lombes, Gascony, France</i> | 43 | 30 N | 0 | 5 E |
| <i>LONDON, Metropo-</i> | | | | |
| <i>lis of England</i> | 51 | 32 N | 0 | 0 |
| <i>Loretto, Tuscany, Italy</i> | 43 | 36 N | 0 | 59 E |
| | | | | <i>Louvain,</i> |

Pole, and Difference of Meridians. 151

| | Latit. | | Dif. Mer. | | CHAP. |
|---|--------|------|-----------|--------------------|--|
| | D. | M | H.M | | XXIV. |
| <i>Louvain</i> , Spanish Provin. | 50 | 40 N | 0 | 19 E |  |
| <i>Lubeck</i> , Holstein, Denmark | 54 | 10 N | 0 | 45 E | |
| <i>Lublin</i> , Poland | 51 | 18 N | 1 | 40 E | |
| <i>Lucca</i> , Tuscany, Italy | 43 | 50 N | 0 | 44 E | |
| <i>Lucern</i> , Switzerland | 46 | 42 N | 0 | 34 E | |
| <i>Lugo</i> , Gallicia, Spain | 42 | 50 N | 0 | 27 E | |
| <i>Lunden</i> , Gothland, Sweden | 55 | 30 N | 0 | 54 E | |
| <i>Luxemburgh</i> , Saxony, Germany | 53 | 10 N | 0 | 43 E | |
| <i>Luxemburgh</i> , France | 49 | 20 N | 0 | 25 E | |
| <i>Lions</i> , Lionois, France | 45 | 40 N | 0 | 19 E | |
| M. | | | | | |
| <i>Madagascar</i> , Africa | 19 | 29 S | 2 | 56 E | |
| <i>Madrid</i> , New Castile, Spain | 40 | 10 N | 0 | 14 W | |
| <i>Maestricht</i> , Spanish Provinces | 50 | 34 N | 0 | 23 E | |
| <i>Magdeburgh</i> , Saxony, Germany | 51 | 45 N | 0 | 50 E | |
| <i>Majorca</i> , in the Mediterranean | 39 | 0 N | 0 | 10 E | |
| <i>St Maloes</i> , Bretagne, France | 48 | 38 N | 0 | 9 W | |
| <i>Malaga</i> , Granada, Spain | 36 | 0 N | 0 | 16 W | |
| <i>Malta</i> , near Sicily, Mediterranean | 35 | 50 N | 0 | 56 E | |
| <i>Malacca</i> , East-Indies | 2 | 8 N | 6 | 42 E | |
| <i>Mans</i> , Orleanois, France | 48 | 5 N | 0 | 1 E | |
| L 4 | | | | <i>Mansfield</i> , | |

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CHAP.
XXIV.

| | Latit. | | | Dif. Mer. | |
|---|--------|----|---|-----------|---------------|
| | D. | M | N | H. | M |
| <i>Mansfield</i> , Saxony, Ger-
many | 51 | 20 | N | 0 | 48 E |
| <i>Mantua</i> , Italy | 45 | 16 | N | 0 | 47 E |
| <i>Manfredonia</i> , Naples,
Italy | 42 | 5 | N | 1 | 6 E |
| <i>Marpurg</i> , Germany | 50 | 30 | N | 0 | 35 E |
| <i>Marfeilles</i> , Provence,
France | 43 | 15 | N | 0 | 23 E |
| <i>Maja</i> or <i>Massa</i> , Tuf-
cany, Italy | 44 | 0 | N | 0 | 43 E |
| <i>Meaux</i> , Isle of France | 48 | 54 | N | 0 | 11 E |
| <i>Mecca</i> , Arabia Felix | 21 | 30 | N | 2 | 34 E |
| <i>Mechlin</i> or <i>Malines</i> ,
Spanish Provinces | 50 | 50 | N | 0 | 9 E |
| <i>Medina</i> , Arabia Felix | 24 | 15 | N | 2 | 22 E |
| <i>Medina-Sidonia</i> , Anda-
luzia, Spain | 36 | 8 | N | 0 | 21 W |
| <i>Meissen</i> , Upper Saxony,
Germany | 50 | 32 | N | 0 | 54 E |
| <i>Mentz</i> or <i>Mayence</i> ,
Germany | 49 | 44 | N | 0 | 33 E |
| <i>Merida</i> , Extremadura,
Spain | 38 | 30 | N | 0 | 21 E |
| <i>Messina</i> , Sicily | 38 | 10 | N | 1 | 3 E |
| <i>Metz</i> , Lorain, Germany | 48 | 50 | N | 0 | 24 E |
| <i>Mexico</i> , North America | 10 | 0 | N | 6 | 56 W |
| <i>St Michael</i> , see Arch-
Angel | | | | | |
| <i>Midnick</i> , Samogitia,
Poland | 55 | 45 | N | 1 | 36 E |
| | | | | | <i>Milan,</i> |

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| | Latit. | Dif. Mer. | CHAP. |
|--|---------|-----------|-------|
| | D. M | H. M | XXIV. |
| <i>Milan, Italy</i> | 45 28 N | 0 38 E | ⌞ |
| <i>Minski, Lithuania, Poland</i> | 54 6 N | 1 53 E | |
| <i>Minorca Island, Mediterranean</i> | 39 10 N | 0 16 E | |
| <i>Mirando, Portugal</i> | 41 10 N | 0 23 E | |
| <i>Mittau, Courland</i> | 56 25 N | 1 40 E | |
| <i>Modena, Italy</i> | 44 30 N | 0 47 E | |
| <i>Montpelier, Languedoc, France</i> | 43 28 N | 0 16 E | |
| <i>Mons, Spanish Provinces</i> | 50 20 N | 0 15 E | |
| <i>Monstiers, Savoy, Italy</i> | 45 6 N | 0 26 E | |
| <i>Monaco, Genoa, Italy</i> | 43 45 N | 0 30 E | |
| <i>Mondonedo, Gallicia, Spain</i> | 43 20 N | 0 28 W | |
| <i>Morlaix, Bretagne, France</i> | 48 38 N | 0 15 W | |
| <i>Moscow, Capital of Muscovy</i> | 55 30 N | 2 38 E | |
| <i>Moulins, Lionois, France</i> | 46 30 N | 0 13 E | |
| <i>Moufol near Old Nineveh</i> | 34 32 N | 2 52 E | |
| <i>Mulhausen, Saxony, Germany</i> | 50 40 N | 0 44 E | |
| <i>Munster, Westphalia, Germany</i> | 51 45 N | 0 31 E | |
| <i>Munchen or Mimick, Bavaria, Germany</i> | 47 45 N | 0 46 E | |
| <i>Murcia, Spain</i> | 37 20 N | 0 3 W | |
| <i>N.</i> | | | |
| <i>Namur, Flanders</i> | 50 10 N | 0 23 E | |
| | | Nancy, | |

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| | Latit. | | | Dif. Mer. | | |
|-------------------------------------|--------|----|---|-----------|----|---------|
| | D. M | | | H. M | | |
| Nancy, Lorrain, France | 48 | 32 | N | 0 | 27 | E |
| Nantz, Bretagne, Franc. | 47 | 12 | N | 0 | 6 | E |
| Nankin or Nanquin,
China | 31 | 0 | N | 7 | 54 | E |
| Naples, Italy | 41 | 45 | N | 0 | 59 | E |
| Napoli di Romania | 37 | 30 | N | 1 | 30 | E |
| Narva, Livonia, Sweden | 58 | 55 | N | 2 | 2 | E |
| Narbonne, Languedoc,
France | 42 | 50 | N | 0 | 12 | E |
| Nassaw, Upper Rhine,
Germany | 50 | 0 | N | 0 | 32 | E |
| Nevers, Orleanois, Fran. | 46 | 50 | N | 0 | 13 | E |
| Newbury, Suabia, Germ. | 48 | 10 | N | 0 | 43 | E |
| Newhausel, Hungary | 48 | 15 | N | 1 | 4 | E |
| Newmark, Transylvania | 47 | 30 | N | 1 | 26 | E |
| Nice or Nizza, Pied-
mont, Italy | 43 | 40 | N | 0 | 29 | E |
| Nigepoli, Bulgaria, Turk. | 45 | 10 | N | 1 | 46 | E |
| Nismes, Languedoc,
France | 43 | 30 | N | 0 | 18 | E |
| Nissa, Servia, Turkey | 43 | 32 | N | 1 | 23 | E |
| Norkoping, Gothland,
Sweden | 58 | 20 | N | 1 | 10 | E |
| Notteburg, Ingria, Swed. | 60 | 0 | N | 2 | 5 | E |
| Novogrod, Weliki, Ruffia | 58 | 10 | N | 2 | 9 | E |
| Nuremburg, Franconia,
Germany | 49 | 0 | N | 0 | 45 | E |
| O. | | | | | | |
| Ocrida, Albania, Turkey | 40 | 18 | N | 1 | 18 | E |
| Oleron, Gascony, France | 43 | 0 | N | 0 | 1 | W |
| | | | | | | Olmutz, |

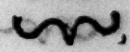
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| | Latit. | Dif. Mer. | CHAP. |
|--|---------|-----------|-------|
| | D. M | H. M | XXIV. |
| <i>Olmutz</i> , Bohemia, Ger-
many | 49 32 N | 1 10 E | |
| <i>St Omers</i> , Flanders | 50 50 N | 0 9 E | |
| <i>Onspack</i> or <i>Anspack</i> ,
Franconia, Germany | 48 50 N | 0 42 E | |
| <i>Orange</i> , Provence, Fran. | 44 10 N | 0 19 E | |
| <i>Oran</i> , Barbary, Africa | 35 30 N | 0 0 | |
| <i>Orbitello</i> , Tuscany, Italy | 42 15 N | 0 48 E | |
| <i>Oresca</i> , see <i>Notteburg</i> | | | |
| <i>Orense</i> , Gallicia, Spain | 42 10 N | 0 29 W | |
| <i>Oricheda</i> , Murcia, Spain | 37 28 N | 0 1 W | |
| <i>Orleance</i> , Orleanois,
France | 47 45 N | 0 7 E | |
| <i>Orvieto</i> , Papacy, Italy | 42 27 N | 0 53 E | |
| <i>Osnaburg</i> , Westphalia,
Germany | 52 10 N | 0 33 E | |
| <i>Otranto</i> , Naples, Italy | 40 52 N | 1 15 E | |
| <i>Oudenard</i> , Flanders | 50 46 N | 0 13 E | |
| <i>Oviedo</i> , Asturia, Spain
P. | 43 10 N | 0 23 W | |
| <i>Padua</i> , Italy | 35 32 N | 0 50 E | |
| <i>Paderborn</i> , Westphalia,
Germany | 51 30 N | 0 36 E | |
| <i>Palencia</i> , Leon, Spain | 42 0 N | 0 17 W | |
| <i>Palermo</i> , Sicily | 37 26 N | 2 30 E | |
| <i>Pampelona</i> , Spain | 42 30 N | 0 5 E | |
| <i>Panama</i> , America | 1 10 S | 5 30 W | |
| <i>Papoul</i> , Languedoc,
France | 42 12 N | 0 9 E | |
| <i>Paris</i> , France | 48 45 N | 0 9 E | |
| <i>Parma</i> , | | | |

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| CHAP.
XXIV. | | Latit. | | Dif. Mer. | |
|----------------|--|--------|------|-----------|------------------|
| | | D. | M | HM | |
| | <i>Parma, Italy</i> | 44 | 42 N | 0 | 44 E |
| | <i>Passaw, Bavaria, Germ.</i> | 48 | 20 N | 0 | 57 E |
| | <i>Pau, Gascony, France</i> | 43 | 15 N | 0 | 1 W |
| | <i>S. Paul de Tricaster,
France</i> | 44 | 20 N | 0 | 19 E |
| | <i>Pavia, Milan, Italy</i> | 45 | 12 N | 0 | 38 E |
| | <i>Pekin, China</i> | 39 | 52 N | 7 | 23 E |
| | <i>Perpignan, Catalonia,
Spain</i> | 42 | 30 N | 0 | 12 E |
| | <i>Pergamos, Natolia, Asia</i> | 37 | 50 N | 1 | 57 E |
| | <i>Perugia, Italy</i> | 42 | 48 N | 0 | 51 E |
| | <i>Pest, on the Danube
over against Buda</i> | 47 | 0 N | 1 | 8 E |
| | <i>Peter-Waradin, Scla-
vonian</i> | 45 | 0 N | 1 | 11 E |
| | <i>Petersburg, Russia</i> | 59 | 25 N | 1 | 59 E |
| | <i>Philipopoli, Romania,
Turkey</i> | 42 | 30 N | 1 | 39 E |
| | <i>Philadelphia, Natolia,
Asia</i> | 38 | 35 N | 1 | 58 E |
| | <i>Pignerol, Upper-Dau-
phine, France</i> | 44 | 48 N | 0 | 30 E |
| | <i>Piombino, Tuscany, Italy</i> | 42 | 54 N | 0 | 45 E |
| | <i>Pisa, Tuscany, Italy</i> | 43 | 55 N | 0 | 45 E |
| | <i>Placentia, Parma, Italy</i> | 44 | 50 N | 0 | 41 E |
| | <i>Placenza, Biscay, Spain</i> | 42 | 45 N | 0 | 8 W |
| | <i>Plazentia, Extremadu-
ra, Spain</i> | 39 | 32 N | 0 | 20 W |
| | <i>Pleskow, Russia</i> | 58 | 10 N | 2 | 16 E |
| | <i>Ploozko, Poland</i> | 52 | 35 N | 1 | 22 E |
| | | | | | <i>Poitiers,</i> |

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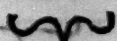
| | Latit. | Dif. Mer. | CHAP. |
|--|---------|--------------|--|
| | D. M | H. M | XXIV. |
| <i>Poitiers</i> , Orleanois, | | |  |
| France | 46 30 N | 0 1 E | |
| <i>PolICASTRO</i> , Naples, Italy | 40 18 N | 1 5 E | |
| <i>Porto</i> or <i>Oporto</i> , Portugal | 40 52 N | 0 31 W | |
| <i>Port Royal</i> , Jamaica | 17 40 N | 5 4 W | |
| <i>Posëga</i> , Sclavonia | 45 25 | 1 2 E | |
| <i>Prague</i> , Bohemia, Ger- | | | |
| many | 50 0 N | 0 58 E | |
| <i>Presburg</i> , Hungary | 48 22 N | 1 2 E | |
| Q. | | | |
| <i>Quebeck</i> , Canada | 47 10 N | 4 41 W | |
| <i>St Quintin</i> , Picardy, | | | |
| France | 49 50 N | 0 12 E | |
| R. | | | |
| <i>Raab</i> or <i>Rab</i> , Bavaria, | | | |
| Germany | 47 50 N | 1 3 E | |
| <i>Ragusa</i> , Dalmatia, Tur- | | | |
| key | 42 25 N | 1 6 E | |
| <i>Ratisbon</i> , Bavaria, Germ. | 48 34 N | 0 49 E | |
| <i>Ravenna</i> , Italy | 44 25 N | 0 51 E | |
| <i>Regio</i> , Calabria, Italy | 38 40 N | 1 5 E | |
| <i>Rennes</i> , Bretagne, Fran. | 48 12 N | 0 6 E | |
| <i>Rethel</i> , Champagne, | | | |
| France | 49 30 N | 0 19 E | |
| <i>Reims</i> , Champagne, Fr. | 49 20 N | 0 16 E | |
| <i>Rhodes</i> Island, Archipe- | | | |
| lago | 35 30 N | 1 57 E | |
| <i>Riga</i> , Livonia | 57 0 N | 1 39 E | |
| <i>Rochel</i> , Orleanois, Fran. | 45 55 N | 0 3 E | |
| | | W | |
| | | <i>Rodes</i> | |

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CHAP.
XXIV.

| | Latit. | D. M | Dif. Mer. | H. M |
|---------------------------------|--------|------|-----------|------|
| <i>Rodes or Rodes, Guienne,</i> | | | | |
| France | 44 | 12 N | 0 | 11 E |
| <i>ROME, Italy</i> | 42 | 8 N | 0 | 52 E |
| <i>Roses, Catalonia, Spain</i> | 41 | 50 N | 0 | 14 E |
| <i>Rosienne, Poland</i> | 55 | 30 N | 1 | 42 E |
| <i>Rosanna, Naples, Italy</i> | 39 | 40 N | 1 | 10 E |
| <i>Rotterdam, Holland</i> | 51 | 50 N | 0 | 17 E |
| <i>Rouen or Roan, Nor-</i> | | | | |
| mandy, France | 49 | 15 N | 0 | 5 E |
| S. | | | | |
| <i>Saintes, Guienne, Franc.</i> | 45 | 45 N | 0 | 2 W |
| <i>Saltsburgh, Bavaria,</i> | | | | |
| Germany | 47 | 20 N | 0 | 54 E |
| <i>Salamancha, Leon,</i> | | | | |
| Spain | 40 | 45 N | 0 | 19 E |
| <i>Salonichi, Theffalonica,</i> | | | | |
| Turkey | 40 | 42 N | 1 | 31 E |
| <i>Saluces, Piedmont, Italy</i> | 44 | 30 N | 0 | 30 E |
| <i>Salerno, Naples, Italy</i> | 41 | 8 N | 1 | 3 E |
| <i>Sallee, Africa</i> | 22 | 25 N | 0 | 31 E |
| <i>Samarcaud, Tartary</i> | 40 | 0 N | 4 | 15 E |
| <i>Sandomir, Poland</i> | 50 | 20 N | 1 | 33 E |
| <i>Santillana, Austria,</i> | | | | |
| Spain | 43 | 10 N | 0 | 14 W |
| <i>Saragosa, Aragon, Spain</i> | 41 | 20 N | 0 | 3 W |
| <i>Saraino, Bosnia, Turkey</i> | 44 | 5 N | 1 | 5 E |
| <i>Sardis, Natolia, Asia</i> | 38 | 10 N | 1 | 56 E |
| <i>Savona, Genoa, Italy</i> | 44 | 25 N | 0 | 36 E |
| <i>Scanderoon, see Alexan-</i> | | | | |
| dretta | 37 | 10 N | 2 | 31 E |
| <i>Schaffhausen,</i> | | | | |

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| | Latit. | | Dif. Mer. | | CHAP. |
|------------------------------------|--------|------|-----------|--|--|
| | D. | M | H.M | | XXIV. |
| <i>Schaffhausen</i> , Switzer- | | | | |  |
| land, Germany | 47 | 28 N | 0 35 E | | |
| <i>Scopia</i> , Servia, Turkey | 42 | 20 N | 1 25 E | | |
| <i>Sculari</i> , Albania, Turkey | 41 | 45 N | 1 13 E | | |
| <i>Sebenico</i> , Dalmatia, | | | | | |
| Turkey | 48 | 38 N | 0 58 E | | |
| <i>Segedni</i> , Hungary | 46 | 10 N | 1 13 E | | |
| <i>Segvia</i> , Old-Castile, | | | | | |
| Spain | 40 | 36 N | 0 15 E | | |
| <i>Sens</i> , Champagne, Fran. | 48 | 0 N | 0 13 E | | |
| <i>Setines</i> , see Athens | | | | | |
| <i>Seville</i> , Andalusia, Spain | 37 | 0 N | 0 20 W | | |
| <i>Severin</i> , Naples, Italy | 39 | 25 N | 1 10 E | | |
| <i>Siam</i> , East-Indies | 14 | 5 N | 6 43 E | | |
| <i>Siena</i> , Tuscany, Italy | 43 | 12 N | 0 46 E | | |
| <i>Sigel</i> , Hungary | 46 | 5 N | 1 5 E | | |
| <i>Silistria</i> , Bulgaria, Turk. | 45 | 6 N | 1 42 E | | |
| <i>Siradia</i> , Poland | 51 | 26 N | 1 17 E | | |
| <i>Sisteron</i> , Provence, Fran. | 44 | 15 N | 0 24 E | | |
| <i>Slezwick</i> , Denmark | 55 | 57 N | 0 39 E | | |
| <i>Smolensko</i> , Muscovy | 54 | 55 N | 2 14 E | | |
| <i>Smyrna</i> , Natolia, Asia | 38 | 4 N | 1 56 E | | |
| <i>Soexaw</i> , Moldavia, Tur- | | | | | |
| key | 47 | 30 N | 1 39 E | | |
| <i>Saiffons</i> , France | 49 | 20 N | 0 14 E | | |
| <i>Sophia</i> , Bulgaria, Turkey | 42 | 32 N | 1 30 E | | |
| <i>Soraw</i> , Bohemia, Germ. | 51 | 35 N | 1 1 E | | |
| <i>Spalaba</i> , Dalmatia, Tur- | | | | | |
| key | 43 | 20 N | 1 2 E | | |

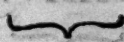
Spires,

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CHAP.
XXIV.

| | Latit. | | Dif. Mer. | |
|--------------------------------------|--------|------|-----------|------|
| | D. | M | H. | M |
| <i>Spire</i> , Upper-Rhine, | | | | |
| Germany | 49 | 0 N | 0 | 33 E |
| <i>Spoletto</i> , Italy | 42 | 28 N | 0 | 55 E |
| <i>Stetin</i> , Pomerania, Ger- | | | | |
| many | 53 | 28 N | 0 | 58 E |
| <i>Stives</i> , Achaia, Turkey | 38 | 10 N | 1 | 34 E |
| <i>Stockholm</i> , Sweden | 59 | 30 N | 1 | 16 E |
| <i>Straßburg</i> , Upper Rhine, | | | | |
| Germany | 48 | 17 N | 0 | 31 E |
| <i>Stugart</i> , Suabia, Germ. | 48 | 30 N | 0 | 37 E |
| <i>Sultzback</i> , Bavaria, | | | | |
| Germany | 49 | 10 N | 0 | 47 E |
| <i>Surret</i> , India | 21 | 30 N | 4 | 47 E |
| <i>Syracuse</i> , Sicily | 35 | 15 N | 1 | 0 E |
| T. | | | | |
| <i>Tangier</i> , Barbary, Africa | 35 | 45 N | 0 | 24 W |
| <i>Targovisco</i> , Turkey | 45 | 45 N | 1 | 34 E |
| <i>Tarante</i> , Naples, Italy | 40 | 40 N | 1 | 11 E |
| <i>Tarragon</i> , Catalonia, | | | | |
| Spain | 40 | 55 N | 0 | 5 E |
| <i>Tavaftus</i> , Sweden | 61 | 20 N | 1 | 43 E |
| <i>Tavira</i> , Algarve, Portug. | 36 | 46 N | 0 | 29 W |
| <i>Temefware</i> , Hungary | 45 | 30 N | 1 | 15 E |
| <i>Tervel</i> , Aragon, Spain | 40 | 0 N | 0 | 5 W |
| <i>Tetuan</i> , Fez, Africa | 35 | 30 N | 0 | 22 E |
| <i>Thebes</i> , see <i>Stives</i> | | | | |
| <i>Tholoufe</i> or <i>Toulouse</i> , | | | | |
| Languedoc, France | 43 | 15 N | 0 | 7 E |
| <i>Thorn</i> , Poland | 53 | 0 N | 1 | 18 E |
| <i>Thyatira</i> , Natolia, Asia | 38 | 28 N | 1 | 54 E |
| <i>Tirol</i> , | | | | |

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| | Latit. | | Dif Mer. | | CHAP. |
|--|--------|------|-------------------|--|-------|
| | D. | M | H.M | | XXIV. |
| <i>Tirol</i> , Austria, Germany | 46 | 15 N | 0 43 E |  | |
| <i>Tokay</i> , Hungary | 48 | 12 N | 1 15 E | | |
| <i>Toledo</i> , New-Castile,
Spain | 39 | 30 N | 0 14 W | | |
| <i>Tortosa</i> , Catalonia, Spain | 40 | 34 N | 0 2 E | | |
| <i>Torneo</i> or <i>Torno</i> , Lapland | 65 | 50 N | 1 34 E | | |
| <i>Tours</i> , Orleanois, France | 47 | 10 N | 0 4 E | | |
| <i>Toulon</i> , Provence, France | 43 | 0 N | 0 25 E | | |
| <i>Tournay</i> , Flanders | 50 | 35 N | 0 14 E | | |
| <i>Trent</i> , Austria, German. | 45 | 50 N | 0 46 E | | |
| <i>Trevigno</i> , Italy | 45 | 45 N | 0 51 E | | |
| <i>Treves</i> or <i>Triers</i> , Lower
Rhine, Germany | 49 | 30 N | 0 27 E | | |
| <i>Tripoli</i> , Barbary, Africa | 33 | 5 N | 0 55 E | | |
| <i>Troppo</i> or <i>Troppaw</i> , Bo-
hemia, Germany | 50 | 15 N | 1 12 E | | |
| <i>Troyes</i> , Champagne,
France | 48 | 5 N | 0 17 E | | |
| <i>Tudela</i> , Navarre, Spain | 41 | 45 N | 0 7 E | | |
| <i>Tunis</i> , Barbary, Africa | 35 | 30 N | 0 51 E | | |
| <i>Turin</i> , Piedmont, Italy | 44 | 50 N | 0 31 E | | |
| <i>Tuy</i> , Gallicia, Spain | 41 | 50 N | 0 33 E | | |
| V. | | | | | |
| <i>Valence</i> , Dauphine,
France | 45 | 0 N | 0 19 E | | |
| <i>Valencia</i> , Valencia, Spain | 39 | 15 N | 0 1 E | | |
| <i>Valladolid</i> , Old-Castile,
Spain | 41 | 28 N | 0 15 W | | |
| <i>Vallona</i> , Albemy, Turk. | 39 | 56 N | 1 12 E | | |
| <i>Vannes</i> , Bretagne, Fran. | 47 | 40 N | 0 10 E | | |
| M | | | <i>Vaudemont,</i> | | |

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CHAP.
XXIV.

| | Latit. | | Dif. Mer. |
|----------------------------------|---------|---|-------------------|
| | D. M | | H. M |
| <i>Vaudemont, Lorrain,</i> | | | |
| Germany | 48 18 N | 0 | 26 E |
| <i>Udine, Venice, Italy</i> | 46 10 N | 0 | 54 E |
| <i>Vendosme, Orleanois,</i> | | | |
| France | 47 45 N | 0 | 4 E |
| <i>Vence, Provence, France</i> | 43 40 N | 0 | 27 E |
| <i>Venloe, Gelderland</i> | 51 10 N | 0 | 25 E |
| <i>Venice, Italy</i> | 45 36 N | 0 | 51 E |
| <i>Verdun, Lorrain, Germ.</i> | 49 10 N | 0 | 21 E |
| <i>Vercelli, Piedmont, Italy</i> | 45 35 N | 0 | 34 E |
| <i>Verona, Venice, Italy</i> | 45 25 N | 0 | 48 E |
| <i>Vic, Lionois, France</i> | 45 20 N | 0 | 14 E |
| <i>Vicenza, Venice, Italy</i> | 45 6 N | 0 | 49 E |
| <i>Viddin, Walachia, Turk.</i> | 44 20 N | 1 | 26 E |
| <i>Vienna, Austria, Germ.</i> | 48 12 N | 1 | 7 E |
| <i>Vienne, Dauphine, Fran.</i> | 45 26 N | 2 | 43 E |
| <i>Vitalio, Macedonia,</i> | | | |
| Turkey | 41 30 N | 1 | 25 E |
| <i>Vitoria, Biscay, Spain</i> | 42 32 N | 0 | 12 W |
| <i>Viterbo, Papacy, Italy</i> | 42 18 N | 0 | 53 E |
| <i>Ulm, Suabia, Germany</i> | 47 55 N | 0 | 41 E |
| <i>Upsal, Sweden</i> | 59 55 N | 1 | 14 E |
| <i>Urbino, Italy</i> | 43 44 N | 0 | 53 E |
| <i>Uscopia, Servia, Turkey</i> | 42 20 N | 1 | 25 E |
| <i>Utrecht, Holland</i> | 52 0 N | 0 | 20 E |
| W. | | | |
| <i>Warsaw, Poland</i> | 52 10 N | 1 | 28 E |
| <i>Waradin, see Peter-</i> | | | |
| Waradin | | | |
| <i>Warbuys, Norway</i> | 71 8 N | 1 | 56 E |
| | | | <i>Waterford,</i> |

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| | Latit. | | Dif. Mer. | | CHAP. |
|--|--------|------|-----------|--|-------|
| | D. | M | H. M | | XXIV. |
| <i>Waterford</i> , Ireland | 53 | 0 N | 0 29 W | | ~~~~~ |
| <i>Weimer</i> , Saxony, Germ. | 50 | 42 N | 0 48 E | | |
| <i>Wesel</i> , Westphalia, Ger. | 51 | 32 N | 0 26 E | | |
| <i>Weysenburgh</i> , Transyl-
vania, Turkey | 46 | 40 N | 1 25 E | | |
| <i>Wiberg</i> , Jutland, Denm. | 56 | 25 N | 0 37 E | | |
| <i>Wiborg</i> , Finland, Swed. | 60 | 50 N | 2 0 E | | |
| <i>Wibitz</i> , Croatia, Turkey | 45 | 0 N | 0 57 E | | |
| <i>Wisbuy</i> , Gotland, Swed. | 57 | 30 N | 1 20 E | | |
| <i>Wittenbergh</i> , Saxony,
Germany | 51 | 28 N | 0 53 E | | |
| <i>Wolfenbittel</i> , Brunswic,
Germany | 51 | 50 N | 0 43 E | | |
| <i>Wormes</i> , Germany | 49 | 12 N | 0 34 E | | |
| <i>Wurtsburg</i> or <i>Wirtsburg</i> ,
Francon. Germany
Y. | 49 | 20 N | 0 41 E | | |
| <i>Yvica</i> , Mediterranean
Z. | 38 | 40 N | 0 5 E | | |
| <i>Zamora</i> , Leon, Spain | 41 | 15 N | 0 21 E | | |
| <i>Zara</i> , Dalmatia, Turkey | 44 | 0 N | 0 56 E | | |
| <i>Zalmar</i> , Hungary | 47 | 52 N | 1 20 E | | |
| <i>Zell</i> , Lunenburgh, Ger-
many | 52 | 30 N | 0 42 E | | |
| <i>Zolnock</i> , Hungary | 47 | 5 N | 1 13 E | | |
| <i>Zurick</i> , Switzerland,
Germany | 47 | 15 N | 0 33 E | | |
| <i>Zutphen</i> , Gelderland,
Holland | 52 | 4 N | 0 24 E | | |

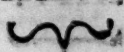
C H A P. XXV.

*Concerning the Motion of the Hands
of a Clock or Watch, as it repre-
sents the Motion of the Sun and
Moon.*

FOR a Conclusion of this Work, I shall here shew my Reader how naturally the *two* Hands of a *Clock* or *Watch* represent the Motions of the *Sun* and *Moon*: For as there are *Twelve* Calendar Months, and *Twelve* Signs in the Zodiack, so also are there *Twelve* Hours upon the Dial Plate of a *Clock* and *Watch*. But as the *Moon* makes *Thirteen* Conjunctions with the *Sun* in *one* Year, that is in the Time the *Sun* *apparent-ly* moves once round the Heavens, so the *Minute-Hand* of a *Clock* or *Watch* makes but *Eleven* Conjunctions with the *Hour-band* in the Time it moves *once* round. For let the *Hour-band* represent the *Sun*, and the *Minute-band* the *Moon*, at 12 *a-Clock* they are *always* together, then they both moving forward, when the *Minute-band* comes again to 12, it doth not find the *Hour-band* there, but is moved *One Eleventh* Part of the whole Revolution further; therefore the

Minute-

Of the Hands of a Clock, &c. 165

Minute-band must go $5^{\circ} 27' 16'' 21''$ CHAP. 49^v $\frac{1}{11}$ before it makes the *next Conjunction* XXV. with the *Hour-band*. And 

Just so it is with the *Sun* and *Moon*; for supposing the *new Moon* to be upon the 10th Day of *March* in the very beginning of *Aries*, they both moving forward according to the order of the Signs.

When the *Moon* comes again to the very beginning of *Aries*, she doth not find the *Sun* there, he is moved $26^{\circ} 55' 46''$ more to the *East* in the *Ecliptick* *, so that the next Conjunction of the *Sun* and *Moon* will be made in *Aries* $29^{\circ} 6' 25'' 12'''$, according to their *middle Motions*, and the next or *second new Moon* would be made in *Taurus* $28^{\circ} 12' 50'' 24'''$; the *Third* in *Gemini* $27^{\circ} 19' 15'' 36'''$; the *Fourth* in *Cancer* $26^{\circ} 25' 40'' 48'''$, &c. every *new Moon* exceeding the Place of the foregoing by $29^{\circ} 6' 25'' 12'''$, but they do not move equally as doth the Hands of a Clock or Watch. Therefore the above *equal Law* of the *Sun* and *Moon* is not exactly observed, however, this may serve well enough to give an *Idea* of the *new Moons*, how it is nothing else but the passing of the *Moon* by the *Sun*, as the *Minute-band* of a Watch doth by the *Hour-band*, as represented by this Table.

* See my *Uranoscopia*, Page 166.

A New and Correct Table shewing the exact Time that the Hands of a Clock or Watch meet through One Revolution, or the whole 12 Hours upon the Dial Plate of a Clock, &c.

| No. | Hours | H. | M | " | ''' | iv | v |
|-----|-------|----|----|----|-----|----|--------------------|
| 1 | 1 | 1 | 5 | 27 | 16 | 21 | 49 $\frac{1}{11}$ |
| 2 | 2 | 2 | 10 | 54 | 32 | 43 | 38 $\frac{2}{11}$ |
| 3 | 3 | 3 | 16 | 21 | 49 | 5 | 27 $\frac{3}{11}$ |
| 4 | 4 | 4 | 21 | 49 | 5 | 27 | 16 $\frac{4}{11}$ |
| 5 | 5 | 5 | 27 | 16 | 21 | 49 | 5 $\frac{5}{11}$ |
| 6 | 6 | 6 | 32 | 43 | 38 | 10 | 54 $\frac{6}{11}$ |
| 7 | 7 | 7 | 38 | 10 | 54 | 32 | 43 $\frac{7}{11}$ |
| 8 | 8 | 8 | 43 | 38 | 10 | 54 | 32 $\frac{8}{11}$ |
| 9 | 9 | 9 | 49 | 5 | 27 | 16 | 21 $\frac{9}{11}$ |
| 10 | 10 | 10 | 54 | 32 | 43 | 38 | 10 $\frac{10}{11}$ |
| 11 | 12 | 12 | 00 | 00 | 00 | 00 | 00 |

EXPLANATION.

The first Column to the left Hand shews the Number of *Conjunctions* of the *Hour* and *Minute-hand*, the *second* contains the *Hours*, the *third* the exact *Times* of their *meeting*.

Of Painting Sun Dials, &c. 167

CHAP.
XXVI.

As for Example.

The *two Hands* are together at 12 a-Clock, and the *next Time* they will be together will be at 5' 27" 16''' 21^{iv} 49' $\frac{1}{17}$ past one, the *Third* meeting will be at 10' 54", &c. past 2, the *Fourth* at 16' 21", &c. past 3 a-Clock, &c. as in the Table, and this is plain enough without any more Examples.

C H A P. XXVI.

Of PAINTING Sun DIALS, and first of the Planes or Surfaces on which DIALS are to be drawn.

DIAL Planes are of *two* Sorts; *first*, such as are made on the Wall of a Building; or *secondly*, such as are drawn on Tables of Wood, vulgarly called *Dial Boards*.

The *first Sort* if they are made on *Brick-work*, is done by plaistering on the Wall with Lime, Sand and Hair, mixed; this must be well drenched with *Linseed Oil*, after it is dry, *i. e.* as long it will drink in any; and then painted with Oyl and white Lead, that it may be durable.

M 4

But

CHAP. XXVI. But a better way is to temper the Lime, Sand and Hair with Ox Blood, which will be no great Charge; but of great advantage; for this Mixture will equal in Time the hardness of a free Stone, and keep the Surface as free from the Injuries of Weather; but you must afterwards paint it white. The following Method is still preferable.

How to make an exceeding strong Cement or Plaister with which to form any Dial Plane upon the Side of a House or Wall, which will endure the Weather, not inferior to Stone.

Take *Lime* and *Sand*, and temper it with *Linseed Oyl* to the Consistency of *Mortar*, or common Plaister, and spread it upon the Wall to a *competent* Thickness, and it will become as hard as a Stone, and last many Ages; and upon this you may describe a Dial, and put on the Lines, Figures and Furniture, as hereafter is directed.

Note, If you are in the Country, remote from any Opportunity of getting *Linseed Oyl*, you may make it with *skimmed Milk*, which will be much superior to Plaister made with Lime Hair, and Water.

If you are to draw a Dial upon a *Stone*, the best Way is to *drench* the Stone with *Linseed Oyl* and *white Lead* mixt *very thin*,
till

till it will drink in no more ; then shall the CHAP.
Dial you paint upon it, last longer and be XXVI.
 the better prepared against the Ruins of
 Time.

Now for Tables or *Dial Boards* of *Wood*, they being the most common, I shall give such Directions for making them, as have been always found most profitable and fit for the Purpose.

The best Woods for this Purpose, are the *clearest Oak* and the *reddest Firr* ; provided it be not full of *Turpentine* ; there is not much Difference between these Two Woods, as to their Alteration by the Weather ; they being both subject to split in case they *are bound*, and have not free Liberty to *shrink* with dry Weather, and *swell* with Wet, though as to their lasting, Oak seems preferable ; tho' good red Firr will last the Age of an ordinary Man, if well secured, as Things of this Nature ought to be.

In working either of these kinds of Woods, the Boards ought first to be cut to such a length as you intend your *Dial Board* shall be, and so many of them as may make up the Breadth designed, and let them be jointed on the Edges, and plained on both Sides, and afterwards set to dry.

For it has been observed, that though Boards have lain in a House ever so long, and are ever so dry, yet when they are thus
shot

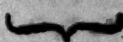
CHAP. *shot and plained, they will shrink afterwards*
 XXVI. *beyond Belief, if kept dry.*

When you think they are dry enough and will shrink no more, let them be shot again with good Joints, and let every Joint be secured with wooden *Dove-Tails*, let in a-cross the Joint in the *Backside*; let this be done after the Boards are glued together and well dried: after it has been thus glued, and the Joints are sufficiently dry, then let the *Face* of the Board be well plained and tried every Way that it may be both *smooth* and *true*, and the Edges shot true and all of a Thickness, as Pannels of Wainscot are commonly wrought.

The *Edges* must be true and even, that they may fit into the *Rabit* of a Moulding, put round it, just as a Pannel of Wainscot does in its Frame.

This Method will give Liberty to the Board to *shrink* without tearing; whereas Mouldings that are nailed round the Edges as the common Way is, do so restrain the Motion of the Wood, that it cannot *shrink* without tearing; but Boards made this Way will last a long Time, without either parting in the Joints or splitting in the Wood.

Dials are some times drawn on Planes lined with *Copper* or *Lead* that they may be free from splitting or tearing; but a Board (*if it be made as before directed*) is to be preferred in many Respects. As *first*, In that

that it is much cheaper. *Secondly*, Both CHAP.
Lead and *Copper* will swell a little with the XXVI.
 Heat of the Sun, and in Time will grow 
bollow outwards, or convex instead of a per-
 fect Flat, which will much pervert the
 Truth of its Shadow. And, *Thirdly*, The
 Colours will be apt to peel from the Metal,
 and the Dial will by that means be in dan-
 ger to be sooner defaced, than if it were
 painted upon a wooden Plane.

*How to make the best Glue for gluing the
 Joints of Boards for Dials.*

Take a *Quart of Milk* that has stood so
 long and been skimmed so often that no
 more Cream will arise; and when skimmed
 very clean boil it a little in a *Leaden Pot*,
 and if any skum yet arise be sure to take it
 clean off; then put into the Milk about
half a Pound of good Glue cut in small Bits
 which will soon melt: boil it to a *good body*,
 but not to be too thick nor too thin; then
 take it off the Fire and keep it for Use.
Note, Care must be taken in the boiling
 that it do not *burn to the Sides of the Pot*,
 for that takes away much of the Strength
 of the Glue; but if it be made with due
 Care, it binds beyond any other Glue, and
 it is better able to resist the Weather, and
 therefore the fittest for gluing Boards for
 Sun Dials.

Care

CHAP. Care must be taken that your Glue be not
 XXVI. made *too thin*, for if it be, the Wood will
 *so drink it up* that it will not be of a *suffici-*
ent Body to bind the Parts together; on the
 contrary, if it be *too thick*, it will not give
 Way for the Joint to *shut close enough* to be
 strongly joined; for though it is Glue that
 makes the Joints stick, yet where there is
 so much of it that the Joint cannot close
 exactly, it will never hold firmly.

Wherever you use your Glue take Care
 that it *be thoroughly hot*, for Glue that is not
 hot never takes firm hold on the Wood.

You must also take great Care that the
 Boards you are to glue have not been *touch-*
ed with Oyl or Grease; for in such Places
 the Glue will never take hold, altho' after
 a Thing is once glued fast, no Grease nor
 Oyl can hurt it.

The Glue being ready, and the Joints
 of the Boards shot true, set *both* the Faces
 of the Joint close together, and both also
turned upward; then dip a Brush in the
 Glue and besmear the Faces of both Joints
as quick as possible, then clap the two Faces
 of the Joint together, and *slide or rub them*
long ways one upon another two or three
 Times to settle them close, and so let them
 stand till they are firm and dry.

How

How to prepare your Oyl for laying on the
Colours upon Dials.

Take One Gallon of Linseed Oyl and set it upon a Charcoal Fire, and when it is about to boil put into it Two Pound of Red Lead, and let it boil together for about an Hour; but the best Way to know when it is boiled enough, is to take a little of it out, and let it cool, and then if it ropes like thin Tar, it is enough: This done put a lighted Paper to it, and set it on Fire to consume the greasy Part of it, which will be done in a Minute or two, more, or less, according to the Quantity of your Oyl; and when it has burnt long enough clap a Cloth or any other Thing close over it, and extinguish the Fire; after which let it cool and settle, then decant the clear Oyl from the Dregs, and keep it in a Bladder for Use.

This is called *drying Oyl*, and with this the several Colours are to be ground in order to paint, so as to endure the Weather; but you must observe that your Colours are thoroughly dry before they are exposed. The several Colours I shall describe hereafter.

N.B. The above Method of making the drying Oyl has one Inconvenience in it, that it makes the Oyl of a deep reddish Colour, which in some Cases may alter the Nature and Beauty,

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CHAP. *Beauty*, of some Colours, as *Whites*, which
XXVI. are liable to become *Yellow*; also *Blues* may
by this means become *greenish*; to prevent
which, in the preparing of your Oyl, in-
stead of *Red Lead* use *Letharge of Gold*.

Of Colours used in Painting Sun Dials.

The Colours generally used in Painting
Sun Dials are :

For *White*, Ceruse and White Lead.

For *Black*, Lamp-Black, Ivory-Black,
Charcoal, and Sea Coal-black.

For *Red*, Red-Lead, Vermillion and Cin-
nabar Lak.

For *Green*, Verdigrease.

For *Blue*, Indigo, blue Bice, blue Verdi-
ter and Smalt.

For *Yellow*, yellow Oker, and yellow
Pink.

For *Brown*, Spanish Brown.

With the above Colours you may com-
pound Variety of other Colours, viz.

An *Ash Colour* is made by mixing a little
Lamp-Black with White.

A *Purple* is made by mixing Cinnabar
Lak and blue Bice.

A *Carnation* is made by mixing Cinnabar
Lak and White.

A *Green*

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A *Green* is made by mixing blue Bice CHAP. with yellow Pink. N. B. Any Blue and Yel- XXVI. low make a *Green* of some Degree or other. 

A *Light Blue* is made by mixing blue Bice and White.

A *Lead Colour* is made by mixing Indigo with White.

A lively *Grass Green* is made by mixing Verdigrease with yellow Pink.

And by this means may several other Colours be compounded and made *lighter* or *darker* at Pleasure, as a little Practice will make evident.

How to prepare the Colours for painting Sun Dials.

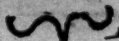
Before you proceed to the painting of Sun Dials in their several Colours, it is first necessary that they be *primed*, that is, painted *Two* or *Three* Times over with Oyl, and Colour prepared for that Purpose, to fill up the Cavities which may (after plaining) remain in the Wood, and to make it perfectly plain, and the more capable to receive and retain other Colours; and of all priming *Spanish Brown* is reckoned to be the chief; for, not to mention its Cheapness, it *dries kindly*, and gives the Oyl a sufficient Time to penetrate into the Wood: and consequently both resists the Weather, and also freely receives all other Colours which

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CHAP. which are laid upon it : it is of itself of a
 XXVI. *Horse-flesh Colour*, and (besides its Usefulness in priming) it is a *natural Shadow* for
 ~~~~~ *Vermillion*, and may be made lighter or darker, according to the greater or less Quantity of *White* mixt with it; tho' in *priming*, it requires not any Mixture, but only the Oyl itself.

In preparing the *Spanish Brown* for priming, grind it very well with the afore-mentioned *drying Oyl*, and make it for the *first priming*, somewhat *thinner* than you would do it for painting, that it may more easily penetrate into the Wood; which being dry, do it over a *second Time* with the same Mixture, only mix it a *little thicker*; and letting that dry, do it a *third Time*, mixing your Colours *thicker* every Time; and take Care in the priming, not only to rub the Brush with the priming all over the Plane, both on the *Back*, as well as on the *Fore-side* and *Edges*, the better to preserve it, but also to *bob* it against it, that the priming may be sure to pierce into all the Cavities or Pores of the Wood: when this last Time of colouring with your priming is dry, then colour the *Face* of the Plane over with *white Lead*, and when it is dry do it over again *Three* or *Four Times* more successively, after each drying; and so will the *Face* of your Plane be of a beautiful white Colour, and it will also be sufficiently defended



fended against the Fury and Violence of the CHAP.  
*Weather* for many Years, when the last XXVI.  
 colouring of your white is dry, your Plane   
 is ready for laying on the Colours, viz.  
 painting the *Hour Lines*, or what *Ornament*  
 or *Furniture* you think fit to have upon it.

OBSERVE as a general Rule that prim-  
 ing is to be mixt or tempered *thin*, but Co-  
 lours for Lines or Figures to endure the  
 Weather, must be tempered *thicker*, the  
 better to resist the Fury of stormy or moist  
 Weather.

*If you are only for making a common Sun  
 Dial, these four Sorts of Colours will be  
 sufficient.*

1. *Spanish Brown*; which prepare, and  
 therewith *prime* your Dial, as before di-  
 rected.

2. *White Lead*, well ground in Oyl;  
 with which, after the priming is *thoroughly*  
*dry*, go over it three or four Times, letting  
 it dry between every Time; which not  
 only makes a beautiful white ground, but  
 fortifies it yet more against the Fury of the  
 Weather.

3. *Lamp-Black*, for drawing the *Hour*  
*Lines* and *Figures*.

4. *Vermillion*, for drawing the *Parallels*  
*of Declination*, or what other *Furniture*  
 you think fit to put upon it.



CHAP. XXVI. The *Spanish Brown*, *Lamp-Black* and *Vermillion*, are all to be ground in the *drying Oyl*, described in Page 173; and for the *White Lead*, it is to be used in the same manner, only in making *drying Oyl*, for *White Lead*, instead of *Red Lead*, use *Litharge of Gold*, and proceed as before.

But if you would have your Dial more rich, you must first consider, what Colours you resolve to have your Lines, Figures, &c. to be, and upon what ground your determined Colours will appear most beautiful. As,

1. *Gold* appears best upon a *Blue* ground, and indifferently upon a *Red*.
2. *Blue* and *Green* appear best upon *Yellow* and *White*.
3. *Red* sets off with *Yellow*, *White*, *Blue*, or *Green*.
4. *Yellow* sets off with *Black*, *Blue*, and *Red*.

Besides the Directions given already for preparing and laying on common Colours, it will be necessary to speak of the laying on the more rich and beautiful Colours; and first of *Gold*.

*How to make Gold Size, with which you design to lay on Leaf Gold.*

Take *yellow Oker*, and grind it with *Water* on a Stone with a Muller, till it be very fine,

*fine*, and then lay it *to dry*, and grind it CHAP.  
 with the afore-mentioned *drying Oyl*, as XXVI.  
 you would grind other Colours, observing ~  
 to put so much of each, that it may be of a  
*competent Stiffness* to work well, and of such  
 a Body, that it may settle itself smooth  
 when laid on, but not *so thin* as to run;  
 and take care to grind it *very fine*, and it  
 will add the greater Beauty to your Gold  
 that is to be laid on with it.

*How to lay on Leaf Gold, or to make any  
 Lines, Figures, &c. of Leaf Gold upon  
 your Dial.*

Draw your Lines, Figures, or Letters,  
 or what you think fit to have in Gold,  
 with *Gold Size*, (abovementioned;) which  
 dry so, that when you touch it with  
 your Finger it will *stick*, but not *come off*;  
 then cut your Leaf Gold as near as you can,  
 into the Form you would have it, whether  
 of Figures, Letters, Lines, &c. (taking  
 Care to cut it rather *too large* than *too little*;) 12  
 and with a flat Stick lined with Cloth, take  
 up your Gold (so cut) and put it upon the  
 Size, and the Gold will leave your lined  
 Stick, and cleave to the Size; then *press it*  
*down* with *Cotton*, or a *Hare's Foot*, and  
 take Care that you make the Figures, Lines,  
 or Letters, in the *Gold Size*; and that you  
 cut the Gold *large enough* to cover the Fi-

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CHAP. gures so made in the Size; and when it is  
XXVI. *thoroughly dry*; brush off all the loose Gold,  
and the painting will remain beautiful, and  
be able to endure the Weather.

*How to lay on Smalt to make a fine Blue.*

When you have laid on what you think fit in *Leaf Gold*, take *white Lead*, mix it *pretty stiff* with *drying Oyl*, and with a Pencil lay that on where you intend your *Blue* shall be, and then put your *Smalt* in a *fine Searce*, and sift it on to the Dial, and with a *Piece of Cotton*, dab it down upon the *White* before laid on, and when it is *thoroughly dry*, wipe off all the loose Colour with a *Feather*, and blow off the Dust with a *Pair of Bellows*, which will easily blow off all, except what fell upon the *White* before laid on to retain the *Blue*, which will be a very beautiful Blue.

*Of the Nature and Colour of some of the principal Ingredients used in painting of Sun Dials.*

I. CERUSE and *White Lead* are the only Colours to be used in painting in Oyl, and besides their Usefulness in painting of Dials, Paint made up with them and Oyl, is frequently made use of in painting Posts, Palisadoes, Gates, Doors, Windows, Wainscoting, &c.



coting, &c. and answers the end of Paint-  
ing, both as to Beauty and Preservation, CHAP.  
for they dry well, and strongly resist the XXVI.  
Weather; and if you would have them to  
*dry yet more speedily*, you may in the *tem-*  
*pering* put in a little *Oyl of Turpentine*, if it  
be *within Doors*; but *without Doors*, it is  
better without, because that does not so  
well resist the Weather.

2. *Lamp-Black* is a good Black, if it be  
first burnt, then ground, and lastly tem-  
pered with Oyl.

3. *Charcoal* is a Black that will serve for  
ordinary Uses; it *dries well*, but great Care  
must be taken that it be *well ground*.

4. *Spanish Brown*; the best is a *deep*  
*bright Colour*, and free from Stones, and  
being very well ground, is the best for  
priming: It is of a *Horse Flesh Colour*, and  
a *proper Shadow* for *Vermillion*.

5. *Red Lead* is a *great Drier* and *Binder*;  
for which Reason, it is made use of in the  
*drying Oyl*; it resists the Weather as well as  
any Colour whatsoever.

6. *Vermillion* is a rich Colour, and of a  
good Body, but Care must be taken that it  
be finely ground, *even as soft as Oyl*, and  
then it will work extraordinary well: It is  
best to buy it *in the Stone*, lest you meet  
with some that has been *adulterated* with  
*Red Lead*, or the like; it is a perfect Scarlet

CHAP. of itself, and may be altered to several Varieties, by mixing with other Colours.

7. *Cinnabar Lak* is a *rich Crimson Colour*, and must be very fine ground.

8. *Smalt* is a very *fine Blue*, and it is best to be *strewed* on, as before taught; for if you work it *in Oyl*, (though you wash it, and mix it with white Lead) yet it will turn *black in Time*; if you buy it to work *in Oyl*, the *finest* is best, which is called *Oyl-Smalt*.

9. *Blue Bice* is a *pale Colour*, and works well though a little sandy.

10. *Blue Verditer* is not so good a Blue as *Bice* and *Smalt*, though it may serve in Dial-painting where they are wanting; but it is a little sandy, and apt to *fade* and *turn greenish*.

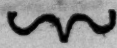
11. *Indigo* is a very *dark Blue*, and commonly lightened with White, when used in Painting, except in shadowing; it grinds fine, and is very proper for the *last Colour* of Posts, Palisadoes, Doors, Windows, &c. for it resists the Weather, and preserves the Wood.

12. *Blue Balls* are almost like *Indigo*, but not so good a Colour, nor will it endure so long.

13. *Umber* is a *Hair-Colour*, it must be very finely ground, which to effect, requires a great deal of Labour; it *dries* and *binds* exceedingly, and is therefore also very pro-



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per for painting without Doors, as Doors, CHAP.  
 Palifadoes; if calcined in a *Crucible*, it is a XXVI,  
*natural* Shadow for Gold, and some other   
 Colours.

14. *Verdigrease* is a perfect *willow green*,  
 but may be altered at Discretion, with *Yel-*  
*low*, &c. but being *very foul*; it must be  
 mended or cleansed, which may be thus  
 done: *Grind it fine, and put to it eight*  
*Times its Weight of Spirit of Vinegar, di-*  
*gest till the Vinegar is tinged very green, then*  
*decant the Colour; cast away the Fæces, and*  
*evaporate the Vinegar in a Brass Vesica, so*  
*have you a very good Verdigrease at the Bot-*  
*tom, much more fine and valuable, than be-*  
*fore it was cleansed; it dries very speedily.*

15. *Yellow Oker*, the *English*, the Colour  
 of *fresh Wheat Straw*; the foreign is of  
 somewhat a *more deep Colour*; it is much  
 used in common painting, being ground  
 very fine.

16. *Yellow Pink* is a *greenish Yellow*; it  
 grinds well, and is good to mix with other  
 Colours to make a *Green*.

Of these Colours some require *washing*,  
 as *Red Lead, Blue Bice, Smalt and Verditer*,  
 which is thus performed.

Put the Colour into a glazed Vessel,  
 and put thereto plenty of clear Water, wash  
 it well, and (after a while) *decant the Wa-*  
*ter; repeat this Work Six or Seven Times;*



CHAP. at last (the Water being but just troubled)  
 XXVI. put it into another glazed Vessel, leaving  
 { the Dregs at the Bottom; then put some  
 more Water into this second Vessel, and  
 wash it as before, till the Water after set-  
 tling be clear, and the Colour remain fine  
 at the Bottom.

*Note*, Before you take the Colour out of  
 the Vessel, *spread it* about the Sides of the  
 Vessel *very thin*; and when it is dry, it will  
 part of it fall down to the Bottom, which  
 keep by itself, but that which sticks to the  
 Sides of the Vessel is the best, and is as  
 fine as any Flower; that strike off with a  
 Feather, and keep it for Use.

The Colours that require *washing* being  
 thus prepared, (or if they are those that do  
 not require washing, they are done with-  
 out) your next Work is *to grind them*,  
 which is done thus:

TAKE a Spoonful or *two* of the Colour  
 you intend to grind, and put to it a little  
*Linseed Oyl*, (but be careful you put in too  
 little rather than too much;) mix them to-  
 gether, and upon your Stone with a Mul-  
 ler, grind them well, adding Oyl by *De-  
 grees*, as you see it requires it, to make it  
 like an Ointment, (always observing that it  
 grinds much better when it is *thick*, than  
 when it is *so thin*, as to run about the Stone;)   
 every now and then scrape it up together  
 with

with a thin *Knife* or *Lantborn-Horn* to keep CHAP.  
it at or near the middle of the Stone, and XXVI.  
so continue to work till you have ground as  
much as you have occasion for; which  
done, clean your Stone by grinding *Sand*  
and *Water* upon it, and then wash and dry  
it, and the Muller; and when you go to  
make Use of it, mix it with *drying Oyl*, till  
it be so thin as to *run freely* from the Pencil,  
yet so thick that the Ground may not *ap-*  
*pear through* it, or to *run* when it is laid on,  
and then it will be the more beautiful Co-  
lour, and better endure the Weather.

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## C H A P. XXVII.

*The manner of Painting Timber  
Work.*

**B**Y *Timber Work* I mean all manner of  
Wainscot, Doors, Windows, Posts,  
Rails, Pails, Gates, Border-boards for Gar-  
dens, &c. to preserve them from the Vio-  
lence of Rain or Injury of the Weather;  
the Method of doing which, I shall here  
lay down as plain as I can.

Suppose then that there be a Set of *Pa-*  
*lisadoes*, or a *Pair of Gates*, or some *Posts*  
and *Rails* to paint, and I would finish them  
in

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CHAP. in a *Stone Colour*; first look over the Work,  
 XXVII. and take Notice whether the Joints be open  
 ~~~~~ in the Gates, or whether there be any large  
Clefts in the Posts; for if these are not se-
 cured, *the wet* will insinuate itself into those
 Defects, and make the quicker Dispatch in
 rotting the whole Work: let the first Bu-
 siness therefore be; stop up these Places
 smooth and even with *Putty*, which is made
 of Whiting and Linseed Oyl, well beaten
 together on the grinding Stone, or with a
 wooden Mallet, to the Consistence of a very
 stiff Dough, and with this let all the Cran-
 nies, Clefts, and other Defects be perfectly
 filled up, that it may be *equal* to the Sur-
 face or Outside of the Stuff; then proceed
 to the priming of the Work with some
Spanish Brown well ground and mixed very
 thin with Linseed Oyl; with this do over
 the Work, giving it as much Oyl as it will
 drink up; this in about *two* Days will be
 indifferent dry: then, if you would do the
 Work substantially, do it over again with
 the same priming Colour; when it is
 thorough dry, then take White Lead well
 ground and tempered up, but not *too thin*,
 for the *stiffer* you work it, if it be not too
 stiff, the better Body will be laid on; and
 the longer it will last: let this Colour be
 well rubbed on with a large Bristle Brush,
 and the whole Surface of the Work be so
 intirely covered, that there remain no Crack
 nor

nor Corner bare, which you may easily do CHAP.
 by *jobbing* in the Point of a Bristle Brush: XXVII.
 Let this first Colouring dry, and then go 
 over it a *second* Time, and if you please a
third also: the Charge will be a little more,
 but the Advantage will be great in the Du-
 ration. This Course is sufficient for any kind
 of *Timber Work* that requires only a plain
 Colour, whether you thus cover the Work
 with a *Stone Colour*, or else with a *Timber*
Colour in Umber and White, or a *Lead Co-*
lour with Indigo and White, that with
 White being cheapest of the Three by
 much: nay I have known some lay over
 their Work only with a Coat of *Spanish*
Brown, by tempering it up more stiff than
 was done for the two first Primings, which
 in some Respects is cheapest of all, and pre-
 serves the Timber perhaps as well as any.
 Now he that is able to bring the Work thus
 far on, has proceeded to the highest pitch
 of that vulgar Painting, that aims at Pre-
 servation beyond Beauty, tho' something of
 Beauty is necessarily included in this also;
 but this is not all, for he that is arrived thus
 far, is in a fair Way to other Perfections in
 the Art of Painting; but for the Painting of
Wainscot with its proper Shadows, and for
 imitating *Olive* and *Walnut Wood*, *Mar-*
bles, and such like, these must be attained
 by too ocular Inspection; it being impos-
 sible to deliver the Manner of the Operation
 by

CHAP. by Precept without Example, and I am
 XXVII. bold to affirm, that a Man shall gain more
 Knowledge by one Day's Experience, than
 by an Hundred spent to acquire it some
 other Way.

I advise therefore all those that desire an
 Insight into this Business, to be a little cu-
 rious, if Opportunity offers, in observing
 the Manner of a Painter's working, not
 only in grinding his Colours, but also in
 laying them on, and working in them, in
 all these observing the Motion of his Hand,
 in the manage of any kind of Tool, and by
 this Means, with a little Imitation joined
 to the Directions here given, I doubt not
 but in a short Time you may arrive to great
 Proficiency in the Business of vulgar Paint-
 ing.

Note, That if when you have made use
 of your Colours, there be occasion for a
 small Cessation till the Work be finished,
 in this Case it is best to cover the Colours,
 if any remain in your Pots with *Water*, for
 that will prevent their *drying*, even in the
 hottest Time.

And for your Pencils, they ought, so
 soon as you have done working, to be well
 washed out in clean Linseed Oyl, and then
 in warm Soap-Suds; for if either Oyl or
 Colours be once dried in the Brush or Pen-
 cil it is spoiled for ever.

It

It has been observed, that Timber laid CHAP.
over with *White*, when it has stood some XXVII.
Time in the Weather, the Colour will *crack*
and *shrink* up together, just as Pitch does,
if laid on any Thing that stands in the Sun;
the Cause of this is the Colour's being laid
on with *too stiff a Body*, for being wrought
too thick once, it will dry with a *skin on the*
outside, which will keep the *inside* moist and
prevent its binding firm, from whence those
Cracks proceed.

Take notice, that if you shall at any Time
have occasion to use either Brushes that are
very small, or Pencils, as in many Cases
there will be occasion, you ought then to
dispose of the Colours you use upon a *Pal-*
let, (which is a wooden Instrument easy to
be had at any *Colour Shop*;) and there work
and temper them about with your Pencil,
that the Pencil may carry away the more
Colour; for *you are to note*, that if a Pencil
be only dipt into a Pot of Colour, it brings
out no more with it than what hangs on the
Outside, and that will work but a little Way,
whereas if you rub the Pencil about in the
Colour, on a Pallet, a good Quantity of
Colour will be taken up in the *Body of the*
Pencil; and besides all this, you may work
your Pencils better to a Point on a Pallet,
than you can do in a Pot; the Point of a
Pencil being of greatest Use in divers Cases,
especially

CHAP. especially in drawing of Lines, and all kind
XXVII. of Flourishing.

I shall still be more particular under this Head of Painting, because Painters Work is very expensive, and is the only Part in Building wherein a Gentleman can be assisting either by himself or Servants, it being almost impossible for any Gentleman to do either Masons, Bricklayers, Carpenters or Smiths Works, whereas it is now well known and experienced, that since the Advertisement of *Alexander Emerton*, several Noblemen and Gentlemen have by themselves and Servants painted whole Houses without the Assistance or Direction of a Painter, which when examined by the best Judges could not be distinguished from the Work of a professed Painter.

And that which conduces most to this Practice is the vast Disproportion between the Prices which Painters charge for their Work, and the Expence which Gentlemen are at in this Method of Painting, which at the utmost doth not amount to *one fourth* Part of the Painter's Price, to prove which I shall set down the Prices of Colours, and likewise shew what *Number of Yards* one Pound of each Colour will paint.

First Primer ground in Oyl, at 36 s. per 112 lb. weight, or 4 d. per lb. One Pound of which will paint 20 square Yards.

Second

Of Painting Timber Work.

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Second Primer ground in Oyl, at 36 s. CHAP. XXVII
per 112 lb. weight, or 4 d. per lb. One Pound of which will paint 12 square Yards.

Best White Lead ground in Oyl at 36 s.
per 112 lb. or 4 d. per lb. One Pound of which, with two pennyworth of Oyl, will paint 8 square Yards, which is three Farthings per Yard, for which Painters usually charge 4 d. per Yard.

1. *Pearl Colour* ground in Oyl at 4 d. and 5 d. per lb.

2. *Lead Colour* ground in Oyl at 4 d. and 5 d. per lb.

3. *Cream Colour* ground in Oyl at 4 d. and 5 d. per lb.

4. *Stone Colour* ground in Oyl at 4 d. and 5 d. per lb.

5. *Wainscot*, or *Oak Colour* ground in Oyl at 4 d. and 5 d. per lb.

N. B. One Pound of any of these five Colours, with Oyl will paint eight square Yards, for which Painters usually charge 4 d. per Yard.

1. *Chocolate Colour* ground in Oyl at 6 d. per lb.

2. *Mahogany Colour* ground in Oyl at 6 d. per lb.

3. *Cedar Colour* ground in Oyl at 6 d. per lb.

4. *Walnut-*

CHAP.
XXVII.4. *Walnut-tree Colour* ground in Oyl at 6 d. per lb.

N. B. One Pound of any of these four Colours with Oyl, will paint 10 square Yards, for some of which Painters usually charge 4 d. per Yard, for others more.

1. *Gold Colour* ground in Oyl at 8 d. per lb.2. *Olive Colour* ground in Oyl from 8 d. to 12 d. per lb.3. *Pea Colour* ground in Oyl from 8 d. to 12 d. per lb.4. *Fine Sky Blue* mixed with *Prussian Blue* ground in Oyl from 8 d. to 12 d. per lb.5. *Orange Colour* ground in Oyl at 12 d. per lb.6. *Lemon Colour* ground in Oyl at 12 d. per lb.7. *Straw Colour* ground in Oyl at 12 d. per lb.8. *Pink Colour* ground in Oyl at 12 d. per lb.9. *Blossom Colour* ground in Oyl at 12 d. per lb.

N. B. One Pound of any of these nine Colours with Oyl, will paint eight square Yards, for some of which Painters usually charge 10 d. or 12 d. per Yard, for others they will expect more.

Fine

Of Painting Timber Work. 193

Fine deep Green ground in Oyl at 2 s. 6 d. per lb. CHAP. XXVII.

N. B. One Pound of which with Oyl, will paint 20 square Yards, for which Painters usually charge 12 d. per Yard.

Oyls used in House-painting are.

1. *Linseed Oyl at 10 d. per Quart.*
2. *Turpentine Oyl at 12 d. per Quart.*
3. *Best drying Oyl at 12 d. per Quart.*

Painting Brushes of several Sizes from 2 d. to 6 d. each.

Putty at 4 d. per lb.

Double Size used by the Painters for priming new Work at 4 s. per Firkin, at 2 d. per Quart.

Single Size at 18 d. per Firkin, or 1 s. per Quart.

These Colours, with all other Materials used in Painting, are prepared in the best manner, and sold by ALEXANDER EMERTON, Colourman, at the Bell over against Arundel-street near St Clement's Church in the Strand, London. He likewise gives printed Directions for the using of his Colours, or procures Painters to work for Gentlemen by the Day, if required.

F I N I S.

To the ingenious Mr Charles Leadbetter.

S I R,

Since no Person hath as yet solved the following Problem, which I proposed * last November, I hope it will not be foreign to your present Design, to insert it in your *Mechanick Dialling*, or *New Art of Shadows*, with its Solution, which if you think proper to do, you will very much oblige a Wellwisher to the *Mathematicks*, and your sincere Friend and humble Servant.

Kirkleatham,
Feb. 1. 1737.



Edward Hauxley.

It is required to know in what *Latitude* of this *terraqueous Globe*, an *Erect South Declining Dial* might be fixed to have these Properties, viz. the *Declination of the Plane*, the *Distance of the Substyle from the Meridian*, and the *Style's height all equal*, as also what Hours on May the 10th 1737, the Sun will come on and go off the Plane.

Solution.

Let x = the Sine of the Plane's Declination, &c. and y = the Sine Complement of the Latitude of the Place, by proceeding some few Steps, (when y is expunged) we have the following Equation, i. e. $x^4 - 3x^2 = -1$: By completing the Square and extracting the Biquadrate Root thereof, when half the Coefficient is duly transposed, x will be found =, 6187 = the Sine of $38^\circ : 13'$ = the Plane's Declination, &c. from whence y is also found =, 7876 = the Sine of $51^\circ : 58'$ the Co-Latitude, hence the Latitude is $38^\circ : 2'$, and in no other Latitude is such a Dial to be erected. From whence it is easy to find when the Sun comes on and goes off the Plane. Q. E. D.

N. B. Since the Quality of the Latitude was not mentioned in the Problem's Datas it may, therefore, be either North or South.

* See the Monthly Oracle and Gentleman's Magazine for November 1736, Page 59.

